

William E. Cummings, Jr.  
Vice President  
Air Pollution Control Systems Sales

November 30, 2004

Ms. Kari Mulinix  
**SOLVAY CHEMICALS, INC.**  
400 County Road 85  
Green River, Wyoming 82935

**RE: SOLVAY CHEMICALS REQUEST FOR QUOTE #104193**  
**FUEL TECH, INC. NOxOUT<sup>®</sup> SNCR PROCESS**  
**PROPOSAL NO. 03-C-084, REVISION 5**

Dear Ms. Mulinix:

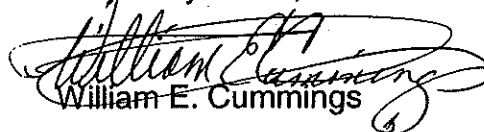
Enclosed you will find two (2) copies of Fuel Tech, Inc.'s Proposal 03-C-084, Revision 5. This proposal is in response to your RFQ #104193 and details the technical and commercial requirements for a NOxOUT SNCR System for Calciners CA-1 and CA-2 at your Green River facility.

We understand this project is authorized to proceed with certain engineering elements at this time. We have elected to provide a complete proposal – engineering, equipment and field support services. We did breakout the prices for the above activities, and while these prices CANNOT be for separate sale, they can be used as limited authorizations to proceed.

As we reviewed your RFQ, we identified certain engineering activities typically contained in the balance of plant engineers scope of supply. While we are capable of providing these services, we did not include these in our offer at this time.

We hope you find this proposal satisfactory for your needs. Should you have questions, comments, or require additional information, do not hesitate to contact Mike Bisnett at (805) 983-2655 or this office.

Very Truly Yours,

  
William E. Cummings

WEC:bav  
Enclosures (2)

cc: Mr. William Stubel – Solvay Chemicals, Inc.  
Mr. Michael Bisnett – FTI-California  
Mr. Kevin R. Dougherty - FTI  
Mr. Erik L. Parks – FTI



**PROPOSAL NO. 03-C-084, Revision 5**

**NOxOUT<sup>®</sup> NOx REDUCTION SYSTEMS**

**FOR**

***SOLVAY CHEMICALS, INC.  
GREEN RIVER, WYOMING  
CALCINERS CA-1 AND CA-2***

**NOVEMBER 30, 2004**

**SOLVAY2016\_1.3\_001400**

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## **PROPOSAL SUMMARY**

In response to Solvay's Request For Quotation referenced above, Fuel Tech, Inc. (FTI) is pleased to submit our commercial proposal covering the design, fabrication, delivery, training and commissioning of one (2) NOxOUT® SNCR Selective Non-catalytic NOx reduction system for the Green River facility in Wyoming.

This proposal covers two (2) coal-fired calciners at Solvay Mineral's Green River facility. The facility produces sodium carbonate that can be used in many industrial processes. The purpose of this proposal is to guarantee the performance of the NOxOUT® process in reducing the NOx from the coal calciner.

It has been determined that the NOxOUT® process can achieve a guaranteed NOx reduction of 35.7% with an ammonia slip of 15 ppm (as measured at the stack and averaged over 30 days). This can be achieved when the conditions that were provided exist for applying the NOxOUT® process

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Coal Calciner  
Green River, Wyoming

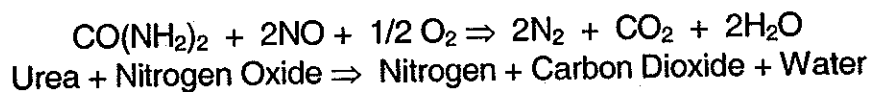
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## TECHNOLOGY DESCRIPTION

### **NOxOUT® SNCR PROCESS DESCRIPTION**

The NOxOUT® Process is a post-combustion NOx reduction method that reduces NOx through a controlled injection of NOxOUT® A or other NOxOUT® reagents into the combustion gas path of fossil-fired and waste-fired boilers, furnaces, incinerators, or heaters. NOxOUT® A is a 50% urea solution plus a small amount of additives for scale and corrosion control. This reagent is readily available and requires no special safety precautions for handling.

The use of urea for control of oxides of nitrogen was developed under the sponsorship of the Electric Power Research Institute (EPRI) between 1976 and 1981. Fuel Tech is EPRI's exclusive licensing agent for the urea-based technology. These early investigations provided fundamental thermodynamic and kinetic information of the NOx-urea reaction chemistry and identified some traces of by-products. The predominant overall reaction is described as:



Though some trace quantities of ammonia and carbon monoxide may form, the quantities of these can often be controlled through application know-how.

The NOx removal efficiency and reagent utilization are related by a variable known as Normalized Stoichiometric Ratio (NSR). This ratio is defined as shown below. NOxOUT® A utilization is equal to the NOx reduction divided by NSR.

$$\text{NSR} = \frac{\text{Actual Molar Ratio of Reagent to Inlet NOx}}{\text{Stoichiometric Molar Ratio of Reagent to Inlet NOx}}$$

Fuel Tech has expanded the technology by developing chemical injection hardware, widening the applicable temperature range, and process control expertise required for commercial applications. Fuel Tech's licensing agreement with EPRI, combined with its successful in-house developments, is marketed commercially under the trade name NOxOUT®.

Two key parameters that affect the process performance are flue gas temperature and the reagent distribution. The NOx reducing reaction is temperature sensitive; by-product emissions become significant at lower than the optimum temperature range while chemical utilization and NOx reduction decrease at higher than the optimum. This optimum temperature range is specific to each application. The reagent needs to be distributed within this optimum temperature zone to obtain the best performance. Typically, the distribution is more difficult for large units and for units with high flue gas velocity.

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## **TECHNOLOGY DESCRIPTION** (-Continued-)

The NOxOUT® Process is designed with the aid of Computational Fluid Dynamics (CFD) and Chemical Kinetic Model (CKM) in addition to results from field tests. The CFD model simulates flue gas flows and temperature inside a unit while the CKM calculates the reaction between urea and NOx based on temperature and flow information from CFD.

A combination of these two models determines the optimum temperature region and the optimum injection strategy to distribute the reagent. With an ability to estimate NOx reduction, a model study can be performed to determine if an application is a right fit for the process.

Utilizing pressurized air, these injectors atomize and direct the NOxOUT® reagents into the combustion gas path. The droplet size distribution and spray coverage developed by the injectors promote efficient contact between the NOxOUT® reagents and the NOx in the flue gas.

The NOxOUT® Process provides effective boiler load following capabilities. Through the computer modeling, an injection strategy is developed that makes use of multilevel injection, control of reagent concentration, droplet size and spray patterns.

Several years of field testing indicate that the NOxOUT® Process is applicable on various types of units firing many different fuels. The process was successfully proven on units fired with coal, oil, gas, wood or municipal solid or hazardous waste. These units varied in size and type: package boilers, process heaters, incinerators, circulating or bubbling fluidized beds, waste heat boilers, utility boilers. By virtue of being a post-combustion process, unit size and type and fuel type have some, but not a major effect on the process.

There are substantial benefits gained from the application of the NOxOUT® Process compared to first generation NOx control technologies, such as ammonia injection. These benefits are briefly summarized below:

- Use of non-toxic, non-hazardous chemicals.
- Potentially lower capital cost due to the lack of large system compressors and elimination of anhydrous ammonia storage, handling, and safety equipment.
- Lower operating costs resulting primarily from minimization of gas (steam or compressed air) requirements.
- Inherently more effective control of spray patterns and chemical distribution for better mixing with the use of liquid rather than gas-based reagents, thereby resulting in better chemical utilization.

# NO<sub>x</sub>OUT<sup>®</sup>

NO<sub>x</sub> Reduction Process

## TECHNICAL BENEFITS

- 30-80% NO<sub>x</sub> reduction
- No liquid or solid by-product for disposal minimizes waste management
- Easy to retrofit – little downtime required
- Minimum space required
- Can be “hybridized” with other NO<sub>x</sub> reduction technologies
- Is “Flexible” - can adjust NO<sub>x</sub> reduction target
- Reagents not subject to SARA, Title III reporting

The NO<sub>x</sub>OUT<sup>®</sup> process is a urea-based Selective Non-Catalytic Reduction (SNCR) process. It provides cost-effective NO<sub>x</sub> reduction for fossil and waste-fueled stationary combustion sources.

Fuel Tech introduced the NO<sub>x</sub>OUT<sup>®</sup> process to provide an economical solution for meeting stringent requirements for NO<sub>x</sub> reduction from fossil-fueled and waste-fueled combustion sources. The NO<sub>x</sub>OUT<sup>®</sup> process converts NO<sub>x</sub> to harmless nitrogen and water.

From 1976 to 1981, research sponsored by the Electric Power Research Institute (EPRI) discovered that urea was an effective reagent for this conversion, and patented the chemical process.

However, this reaction takes place only in a narrow temperature range, below which ammonia (NH<sub>3</sub>) is formed and above which NO<sub>x</sub> emission levels are compromised.

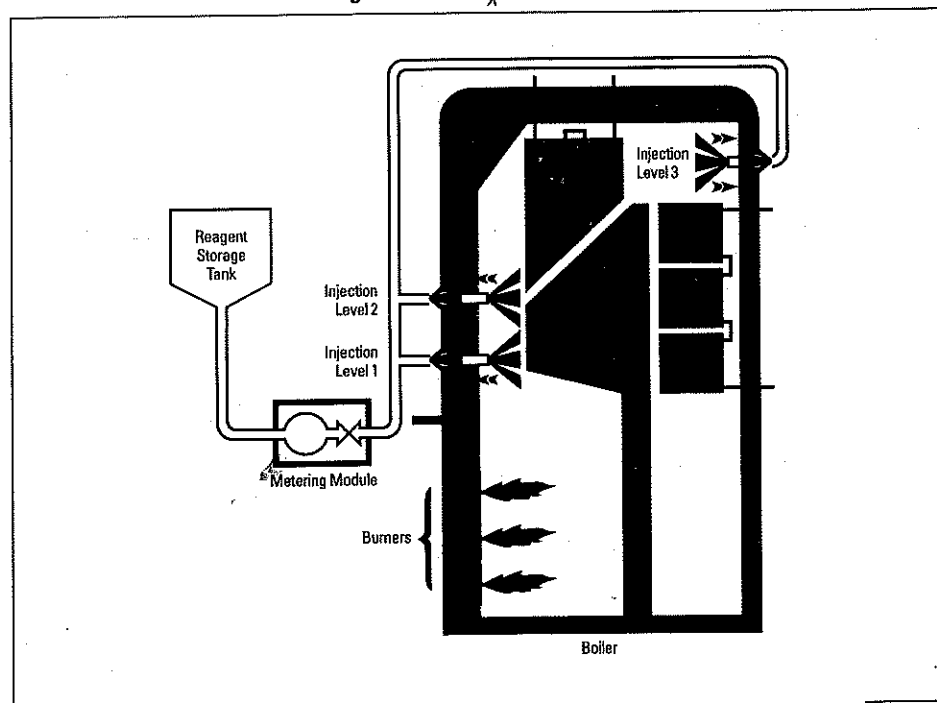
The NO<sub>x</sub>OUT<sup>®</sup> system uses process

and mechanical modifications to significantly widen the temperature range over which the process is effective. Fuel Tech has developed this technology and commercially licenses it both directly and through selected licensing agents throughout the world.

## What Makes the NO<sub>x</sub>OUT<sup>®</sup> Process Different?

Two of the most important features of the NO<sub>x</sub>OUT<sup>®</sup> process are its low energy consumption, typically 20-40 kW, and its ability to control ammonia slip, which may occur as a by-product of incomplete NO<sub>x</sub> reduction. The NO<sub>x</sub>OUT<sup>®</sup> process uses particle momentum control technology instead of “brute force” (in the form of high volume mixing air or steam—1 to 4% of flue gas volume) to achieve appropriate reagent distribution.

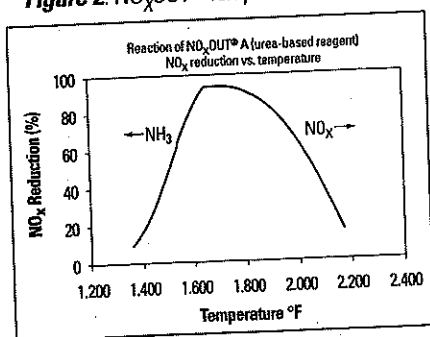
Figure 1: The NO<sub>x</sub>OUT<sup>®</sup> Process



Excessive ammonia slip adds another pollutant to the flue gas, can cause plugging of air preheaters through the formation of ammonium bisulfate, and also can cause contamination of fly ash and flue gas desulfurization waste water. Unlike other SNCR processes, the NO<sub>x</sub>OUT<sup>®</sup> technology is able to control ammonia slip to very low levels. (Refer to Figure 3.)

Combustion modification such as low NO<sub>x</sub> burners and over-fire air are effective, yet normally only permit NO<sub>x</sub> reductions up to 50% on liquid- or solid- fueled boilers. To date, there has been a sharp increase in cost when further NO<sub>x</sub> reductions are required using selective catalytic reduction (SCR). SCR entails substantial capital cost and high operating costs associated with reactor construction and erection, catalyst replacement, pressure drop through the system, and ammonia consumption.

**Figure 2: NO<sub>x</sub>OUT<sup>®</sup> Temperature Window**

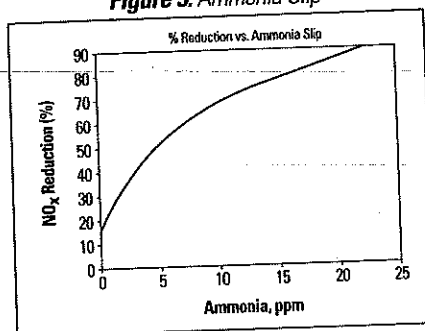


The NO<sub>x</sub>OUT<sup>®</sup> process can be used as a "stand-alone" technology to achieve up to 80% NO<sub>x</sub> reduction, or it can be combined or "hybridized" with other NO<sub>x</sub> reduction technologies to achieve SCR-type performance (>85% NO<sub>x</sub> reduction) at a significantly lower

The NO<sub>x</sub>OUT<sup>®</sup> process has been commercially installed on a wide range of combustion units burning such fuels as:

- Coal
- Lignite
- Oil
- Gas
- Municipal solid waste
- Refinery/CO gas
- Sludge
- Wood
- Fiber
- Biomass

**Figure 3: Ammonia Slip**



Commercial combustion units include:

- Refinery crude heaters and CO boilers
- Sludge combustors
- Industrial power boilers
- Municipal waste combustors
- Incinerators
- Circulating fluidized bed boilers
- Stoker-fired boilers burning wood and coal
- Package boilers
- Tangentially-fired utility boilers
- Cyclone-fired utility boilers
- Wall-fired utility boilers (wet & dry)

The NO<sub>x</sub>OUT<sup>®</sup> process is also well suited to process combustion units, such as:

- Cement kilns
- Glass furnaces
- Ethylene furnaces
- Calciners
- Coke ovens

The NO<sub>x</sub>OUT<sup>®</sup> process can be easily retrofitted to most existing units. Fuel

Tech can perform a NO<sub>x</sub>OUT<sup>®</sup> process demonstration, via mobile equipment, to predict and optimize the technology's operating results on a commercial application.

In the design phase of a NO<sub>x</sub>OUT<sup>®</sup> process application, Fuel Tech uses computational fluid dynamics (CFD) and chemical kinetic modeling (CKM) to aid in injector location selection, and determine the appropriate reagent droplet size distribution. Combustion unit temperature mapping and operating data are model inputs and are used to achieve high NO<sub>x</sub> reduction and low by-product emissions, and prevent impingement on heat transfer surfaces.

**Figure 4: CFD Model of Tangential Boiler**

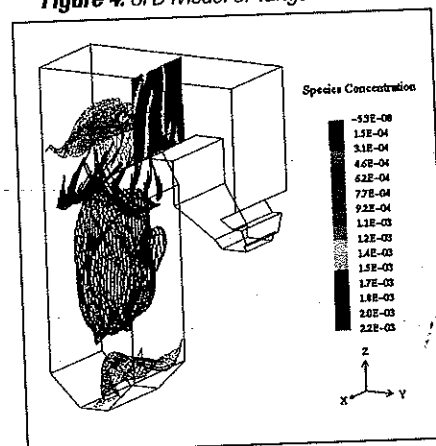


Figure 4 shows modeling results from a 750-MW tangentially-fired utility boiler burning coal. It shows 14 injectors placed at a certain elevation, spraying at a certain angle. The model then predicts the reagent concentration at various cross-sections and superimposes this information on flue gas temperatures and velocity. This modeling information is used to design a NO<sub>x</sub>OUT<sup>®</sup> process application to meet the needs for tightening pollution control restrictions in the Northeast United States.



Under Engineering Services Agreements, Fuel Tech performs CFD/CKM modeling studies on combustion units to predict NO<sub>x</sub> reduction performance and by-product emissions. To optimize the NO<sub>x</sub>OUT<sup>®</sup> technology, Fuel Tech has developed equipment and components including:

- Specific injection equipment to ensure that the NO<sub>x</sub>OUT<sup>®</sup> reagents are distributed optimally in the combustion unit flue gases
- Control hardware and software to enable the NO<sub>x</sub>OUT<sup>®</sup> process to follow load changes and spikes in stack NO<sub>x</sub> with the appropriate flow rates and mixtures of reagents
- Modular equipment for storing, mixing, metering, and pumping the NO<sub>x</sub>OUT<sup>®</sup> reagents to reduce retrofit costs

**Figure 5: Cost and Performance of the NO<sub>x</sub>OUT<sup>®</sup> Process on Various Units**

Electric Utility NO <sub>x</sub> OUT <sup>®</sup> Applications					
	Boiler Type	MW	NO <sub>x</sub> REDUCTION %	CAPITAL \$/kw	TOTAL ANNUALIZED USE COST \$/Ton NO <sub>x</sub> REMOVED
<b>Coal</b>	Tangentially Fired	150	40%	\$ 23.00	\$ 1,775
	Wall Fired	600	25-30%	\$ 10.50	\$ 1,300 *
	Cyclone	160	36%	\$ 12.50	\$ 980
	Cell Fired	600	30%	\$ 12.00	—
	Circulating Fluidized Bed	45	60%	\$ 14.30	\$ 1,380
	Wet Bottom, Wall Fired	320	30-35%	\$ 13.00	\$ 1,275 *
<b>Oil</b>					
	Tangentially Fired	160	40 %	\$ 15.00	\$ 1,200

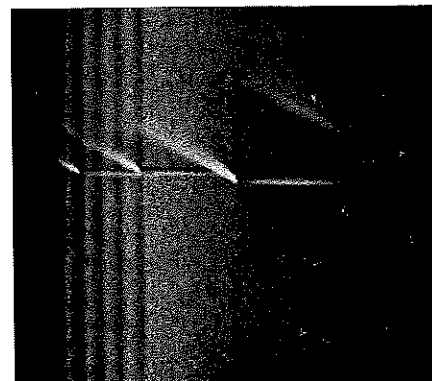
Industrial Units		
INDUSTRY TYPE	NO <sub>x</sub> REDUCTION %	TOTAL ANNUALIZED USE COST \$/Ton NO <sub>x</sub> REMOVED
Refining Industry		
CO Boiler	65%	\$712
GT HSRG	50%	\$1,135
Package Boiler	60%	\$1,900
Process Heaters	60 - 75%	\$1200 - 1600
Pulp and Paper Industry		
Power Boiler	50%	\$1,032
Recovery Boiler	60%	—
Sludge Combustor	50%	\$1,424
Industrial Boilers	50%	\$1,012
Municipal Waste Combustor Industry		
Municipal Waste Combustor	40 - 70%	\$1040 - 1553
Wood Fired IPP / Cogen Industry		
Wood Fired IPP / Cogen	35 - 70%	\$918 - 2222
Tire Burner Industry		
Tire Burners	50%	\$1,418

Fuel Tech is an international company working at the forefront of combustion technology, with a particular objective to meet the increasing demands for cost-effective pollution control technologies and equipment. In addition to the NO<sub>x</sub>OUT® process, Fuel Tech's products include:

- Enhanced fuel additive technologies
- Control programs for corrosion, particulate emissions, and fireside deposition
- The NO<sub>x</sub>OUT Cascade® Process can remove up to 90% of NO<sub>x</sub> using a compact SCR catalyst in conjunction with the NO<sub>x</sub>OUT® SNCR process.
- The FLGR™ (Fuel Lean Gas Reburn)/NO<sub>x</sub>OUT® Process can provide an alternative to full SCR systems, but without the capital expense, catalyst replacement expense, or "stranded asset" potential of a SCR system.
- The NO<sub>x</sub>OUT SCR® Process for industrial generators provides a cost-effective and safer alternative to ammonia-based SCR systems.



**Figure 6:** Modular control and feed system delivered to site ready for hook-up.



**Figure 7:** Typical through-wall NO<sub>x</sub>OUT® injector

For more information on NO<sub>x</sub> reduction programs available from Fuel Tech, call, fax, or write us at:

Fuel Tech, Inc. • 512 Kingsland Drive • Batavia, IL 60510  
 Phone 800.666.9688 • 630.845.4500 • Fax 630.845.4501  
[www.fueltechnv.com](http://www.fueltechnv.com) • [webmaster@fueltechnv.com](mailto:webmaster@fueltechnv.com)





## **COMPUTATIONAL FLUID DYNAMICS MODEL (CFD)**

Fuel Tech creates computer models of clients' units as part of the NOxOUT<sup>®</sup> engineering design process. A technique known as Computational Fluid Dynamics (CFD) is used to estimate the flue gas properties locally within the unit, and subsequently to assist in the determination of appropriate injector locations and characteristics for proper NOx control. Once constructed, the computer model can be modified to estimate the effects of changes in operating conditions.

The model is performed using the PHOENICS (CHAM) CFD program, with process-specific correlations provided through subroutines proprietary to Fuel Tech. The proprietary subroutines perform multi-component droplet dynamics calculations, provide physical property correlations and transport coefficient estimates, and perform supplemental computational or visualization functions. The correlations and approximations employed within the model are selected at the discretion of Fuel Tech as appropriate and acceptable for application of the NOxOUT<sup>®</sup> technology.

Process models are not restricted to routine NOxOUT<sup>®</sup> applications. The available technology can be applied to many different processes in which fluid flow influences physical or chemical performance. A significant benefit of the CFD methodology is its ability to provide insight about process operations in new application areas.

The model contains many cells which closely approximate the geometry of the client's unit. Each cell is associated with a set of coefficients describing the flue gas properties therein. Some of these properties are temperature, density, velocity, and composition. Certain cells are identified as mass or energy sources, others as places where mass or energy leave the system. Mass, energy, and momentum balances are repetitively performed on all cells until the coefficients no longer change between iterations (i.e., the solution is "converged"). The converged results are then displayed using a post-processing program.

In a typical NOxOUT<sup>®</sup> project, the unit is modeled without injection to determine the temperature and flow behavior. Once an appropriate temperature regime is identified, a model simulating injection is performed. Injector characteristics are adjusted to provide the best chemical distribution subject to the intrinsic constraints for that unit. This process is repeated for each set of operating conditions. Final model refinement is performed as an engineering service at the time of NOxOUT<sup>®</sup> System installation.



## **COMPUTATIONAL FLUID DYNAMICS MODEL (CFD)** ( Continued )

Input data describing the physical unit and its operations will be supplied by the client. These data must be sufficient to establish the unit structure and all mass and energy inputs (or outputs) to the unit for each evaluated condition. Preferably, the structural data will be provided as an annotated set of process blueprints including, but not limited to a side sectional profile, front sectional profile, and plan view. Burners, secondary or other air inlet ports, flow diverters, and other features which influence the flue gas flow or distribution should be clearly indicated. Refractory lining, tube spacing, and other factors influencing heat transfer should also be shown.

Operational data must include the mass flow rate and temperature of each mass source for the unit (fuels, combustion air, flue gas re-circulation, waste gas sources, etc.). The mass flow information should be actual rather than on a dry basis. The heating value, physical state, and composition (including moisture) are required for the fuel. If specific information is not available, for instance as is often the case for primary/secondary air distribution, the client is requested to provide his or her best estimate of that value. Additional process information may be requested by Fuel Tech if required to properly complete the model.

Actual field data should be provided when available. These data provide a basis for the interpretation of model results and decreases design uncertainty. The field data also allow the model to be fine-tuned to the client's unit in order to more closely represent the true operating conditions in the event that the standard estimates are of insufficient accuracy.

A report describing the final model results will be prepared and provided to the client. The report will include a presentation of the model results, brief description of the technology employed, and supplemental discussions addressing data interpretation and conclusions. Every effort will be made to supply the client with sufficient documentation to adequately represent the model results. (Under no conditions will source code or data input files be released to the client, as these contain proprietary information.) An example of typical output information is attached.

The final results represent, in the opinion of Nalco Fuel Tech, the best available estimate of the conditions within the unit, recognizing the limitations of the model and the approximations employed.

## Computational Fluid Dynamic Modeling Results

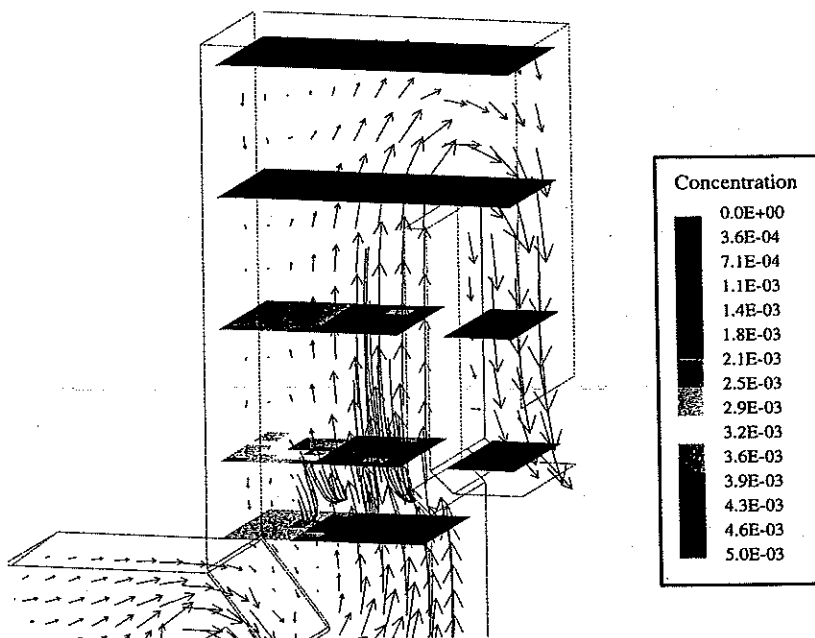
This figure is a three dimensional chemical distribution profile generated via Fuel Tech's computational fluid dynamics (CFD) model. Combustion unit operating data, fuel analyses, and NOxOUT<sup>®</sup> Process design parameters are inputs to the CFD model.

250 ton/day Municipal Waste Combustor	
NOx Baseline .....	200ppm
NOx Reduction .....	60%
NH3 Slip .....	<15ppm

CFD modeling results determine:

- flue gas temperature and velocity profiles (and contours)
- available reaction time
- reagent droplet path
- where carrier water evaporates, and the concentration of reagent at various "planes" within the unit
- an injection strategy that prevents impingement on heat transfer surfaces

This information is combined with results from our chemical kinetic model and is used to predict NOx reduction performance and potential by-product emissions.



The NOxOUT<sup>®</sup> Process is Fuel Tech's urea-based, selective non-catalytic reduction process for reducing nitrogen oxides in waste-fueled or fossil-fueled stationary combustion sources (or process units).

Fuel Tech also offers Engineering Services to perform combustion unit computer modeling. Fuel Tech's CFD/CKM modeling is used to predict potential by-product emissions and NOx reduction performance. These are critical pieces of information for developing a 1990 Clean Air Act Amendment compliance strategy.

For more information on NOx Reduction programs available from Fuel Tech, call, fax, or write us at:

Fuel Tech, Inc.  
P.O. Box 3031

Naperville, IL 60566-7031

Phone - 1.800.666.9688 / Fax - 630.983.3240





## CHEMICAL KINETIC MODEL

The chemistry of the NOxOUT<sup>®</sup> Process involves over ninety individual chemical reactions describing interactions among thirty-one species. To understand the effects of process parameters, an ideal chemical kinetic model was developed. This model describes an ideal plug flow, i.e., no temperature or species concentration gradient in radial direction and no back-mixing. Species concentrations with this type of flow are described by a set of ordinary differential equations. The number of equations depends on the number of species being modeled, and the equations are interrelated through reaction rates. Enthalpy equations are neglected in the model. Instead, measured or estimated temperature profile is a model input. Reaction rates, density, and thermodynamic information are supplied by a library of gas-phase subroutines called CHEMKIN developed at the Sandia National Laboratories. This package of subroutines compiles user supplied reaction sets and a thermodynamic data file. The resulting set of differential equations are integrated simultaneously using a numerical integrator called LSODE. This solver was developed at the Lawrence Livermore National Laboratory and has been shown to be most efficient in solving combustion problems. Initial condition for the calculation is the equilibrium concentrations of species at temperature and excess O<sub>2</sub> as measured. Measured NOx concentration is also an input. Equilibrium concentration is calculated using a program called STANJAN developed at Stanford University. The components of the NOxOUT<sup>®</sup> Kinetic Model are shown in Figure 1.

The reaction set is adapted from the work of Miller and Bowman. The wet CO oxidation reactions, ammonia oxidation reactions, and HCN oxidation reactions make up the set. The major pathway of urea breakdown and reaction with NOx is shown in Figure 2. Result from the developed model was then compared with experimental results obtained in our laboratory combustor as shown in Figure 3. Theoretical and experimental results agreed well; temperature window and magnitude of NOx reduction were closely predicted by the model. The developed model was then used to understand the effects of temperature, treatment rate, baseline NOx, CO concentration, excess oxygen concentration and residence time. These results were presented at the Pittsburgh Coal Conference and the AFRC Meeting.

An example of the procedure and the benefits of modeling study is illustrated as follows: NOx reduction was required from a boiler with a sketch of its upper furnace as shown in Figure 4. The objectives were to select injection locations and to determine achievable NOx reduction. Temperature estimations at furnace exit, cavity 2 and cavity 4 and NOx, O<sub>2</sub>, and CO concentrations were provided. Temperatures vary as much as 300°F in vertical direction inside cavities. To account for this, three streamlines as shown in Figure 4 were selected and corresponding temperature-residence time profiles were



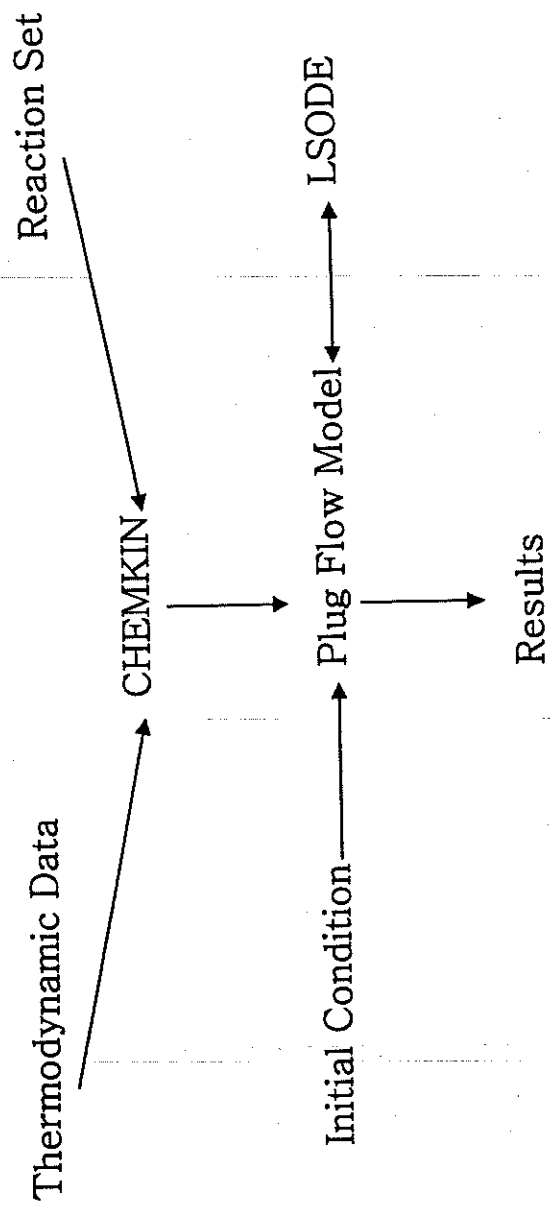
## **CHEMICAL KINETIC MODEL**

( Continued )

established as shown in Figures 5, 6 and 7. Based on temperature data, chemical injections at furnace exit and cavity 1 were ruled out because high temperatures that exist at these zones reduce NOxOUT® Process performance. Injection at cavity 2 for three streamlines reduced NOx as shown in Figures 8, 9, and 10. NOx decreased from a baseline of 450 ppm to 280, 90, and 20 ppm for streamlines 1, 2, and 3 respectively. To obtain higher reduction for streamline 1, chemical was injected into cavity 3; NOx was reduced to around 50 ppm. Therefore, injectors should be located at the lower half of cavity 3 and the upper half of cavity 2. The achievable controlled NOx concentration is less than 100 ppm. (NOx reduction of >75%.)



**-NOxOUT Kinetic Model-**



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### PROCESS DESIGN TABLE

Unit and NOx Designation	Coal Calciner
Fuel Fired	Coal
Maximum Heat Input	155 mmBtu/hr
NOxOUT® Process (SNCR)	
Uncontrolled NOx(lb/mmBtu) (lb/hr)	0.45 70.0
Controlled NOx (lb/mmBtu) (lb/hr)	0.29 45
SNCR NOx Reduction (%)	35.7
Furnace CO Limit (ppm) @ Elevation 16' 4"	200
NOxOUT® A Consumption(gph) @ 100% MCR/Unit	15
Ammonia Slip (ppm)	15
Expected Furnace Temp (F) @ Elevation 15' 6"- Tempering Air Ports	1700-1750

**Notes:**

1. All Guarantees Based Upon 30-Day Rolling Average.
2. Furnace Conditions Based Upon Data Supplied By Detroit Stoker – "Original Case" Except For NOx Baseline Which Comes From Their Commercial Guarantee Position.

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## **FUEL TECH EQUIPMENT SCOPE OF SUPPLY**

- 1 15,000 GAL CAPACITY FRP NOxOUT®A STORAGE TANK**
- 1 SLP3-C CIRCULATION MODULE**
- 1 CIRCULATION MODULE ENCLOSURE - (10' x12' x 8' IHC)**
- 2 SLP3-M-ILC METERING MODULE**
- 4 SLP3-D-6 DISTRIBUTION MODULE**
- 24 SLP3-I-NFTL WALL-MOUNTED INJECTOR**
- 12 SLP3-AR-P INJECTOR RETRACT MECHANISM**
- 2 RETRACT CONTROL PANEL**
- 2 OPTICAL TEMPERATURE PYROMETER**
- 1 CONTROL ROOM COMPUTER**

Solvay Minerals  
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Green River, Wyoming

November 30, 2004  
Proposal 03-C-084, Rev. 5  
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## **FUEL TECH EQUIPMENT SCOPE OF SUPPLY**

### **15,000 GALLON NOMINAL CAPACITY NOxOUT® A STORAGE TANK**

Made of Fiberglass Reinforced Plastic (FRP) with Premium Grade Vinylester Resin. Fabricated per ASTM D3299-88 where applicable, 1.5 Specific Gravity, heating package to maintain 80°F, site specific variables include seismic zone, wind load, snow load, and temperature variance.

Also includes heat trace and insulation with thermostat control, level transmitter, manway, vent, internal downpipe, external fill pipe, thermocouple, ladder, hold down and lifting lugs, FRP flanges for inlet and outlet, and fill and circulation line valves for suction isolation, drain, and return control.

*Typical size: 12' OD x 21.8' SS x 23.8' OAH; Approximate Weight: 5,900 lbs.*

**Reference FTI Drawing C-1**

### **CIRCULATION MODULE (SLP3-C)**

The Circulation Module is designed for the continuous circulation and heating of the NOxOUT® A chemical and the supplied feed of the reagent into the Metering Module(s). The NOxOUT® tank level indication and alarms will be mounted on this module adjacent to the local control panel.

The Circulation Module includes: Complete assembly and testing, local control panel (NEMA 4X), redundant SS centrifugal pumps with auto switch, TEFC motors, motor starters, stainless steel skid with basin, 3 kW electric heater, duplex strainer for chemical, flow sensor and indicator for NOxOUT® A reagent, reagent temperature indicator, tank level indication, and all necessary SS components, piping, (Schedule 40 socket welded), and fittings.

*Typical size: (4"W x 7'L x 6'H) Approximate weight: 1,500 lbs.*

**Reference FTI Drawing D-1**

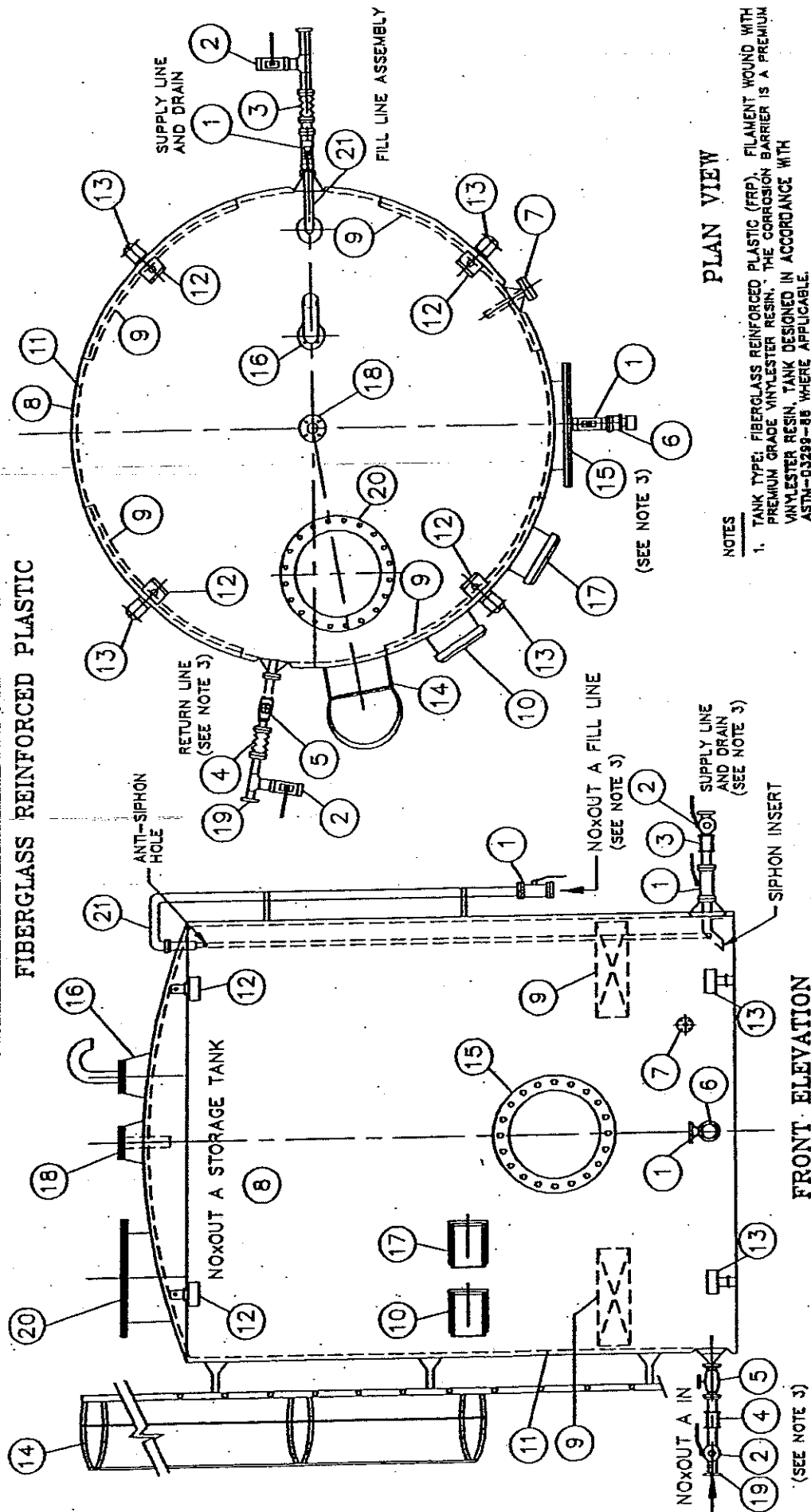
### **CIRCULATION MODULE ENCLOSURE (10' x 12' x 8' IHC)**

The Circulation Module enclosure is a prefabricated weather-resistant, heated and ventilated building which contains the SLP3-C module, interconnecting piping, and wiring – all pre-assembled/wired prior to shipment. This enclosure should be located within close proximity to the reagent storage tank.

**Reference FTI Drawing J-9**

# NOXOUT® SYSTEM STORAGE TANK

FIBERGLASS REINFORCED PLASTIC



## NOTES

1. TANK TYPE: FIBERGLASS REINFORCED PLASTIC (FRP). FILAMENT WOUND WITH PREMIUM GRADE VINYLESTER RESIN. THE CORROSION BARRIER IS A PREMIUM VINYLESTER RESIN. TANK DESIGNED IN ACCORDANCE WITH ASTM-D3299-88 WHERE APPLICABLE.
2. PROVIDED WITH HOLD DOWN LUGS, LIFTING LUGS AND HEATING PADS. QUANTITIES AND LOCATIONS ON TANK ARE SITE SPECIFIC.
3. VALVES AND THEIR ASSOCIATED FITTINGS ARE SHIPPED LOOSE. FILL LINE, LADDER ASSEMBLY, TEMPERATURE ELEMENT AND LEVEL TRANSMITTER ARE ALSO SHIPPED LOOSE. CUSTOMER TO INSTALL THESE ITEMS. LOCATIONS ON TANK ARE SITE SPECIFIC.

ITEM	DESCRIPTION	ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	BALL VALVE - 2"	8	STORAGE TANK	15	COVERED MANWAY (SIDE)
2	BALL VALVE - 1"	9	HEATING PADS	16	VENT
3	EXPANSION JOINT - 2"	10	HEATER CONTROL BOX	17	CONTACTOR BOX
4	EXPANSION JOINT - 1"	11	2" INSULATION	18	SPARE FLANGE
5	GLOBE VALVE	12	LIFTING LUGS	19	RETURN FLANGE
6	LEVEL TRANSMITTER	13	HOLD DOWN LUGS	20	COVERED MANWAY (TOP)
7	TEMPERATURE ELEMENT WITH THERMOWELL	14	LADDER ASSEMBLY	21	FILL LINE ASSEMBLY

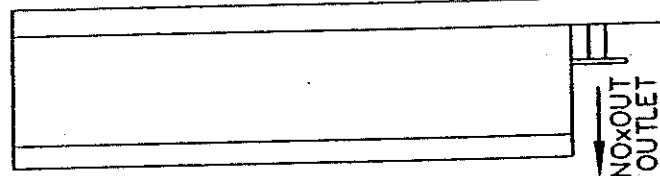
DWG. NO.		C-1	
FUEL TECH, INC.		830-848-4300	
DATE: 5/30/00		515 KINGSLAND DRIVE BATAVIA, IL 60103-2100	



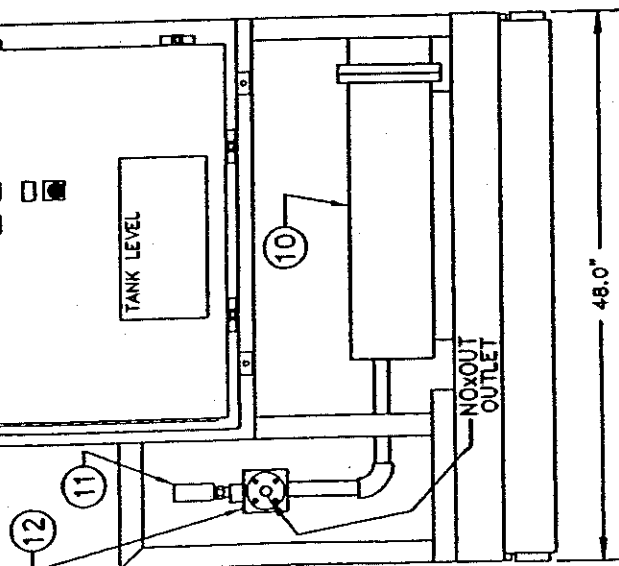
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# FUEL TECH NOxOUT SLP3 CIRCULATION MODULE

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	PRESSURE GAUGE	7	MOTOR
2	CIRCULATION PUMP	8	PRESSURE GAUGE
3	MOTOR	9	DUPLEX STRAINER
4	BALL VALVE	10	IN-LINE HEATER
5	BALL VALVE	11	TEMPERATURE INDICATOR
6	CIRCULATION PUMP	12	FLOW ELEMENT



FRONT ELEVATION



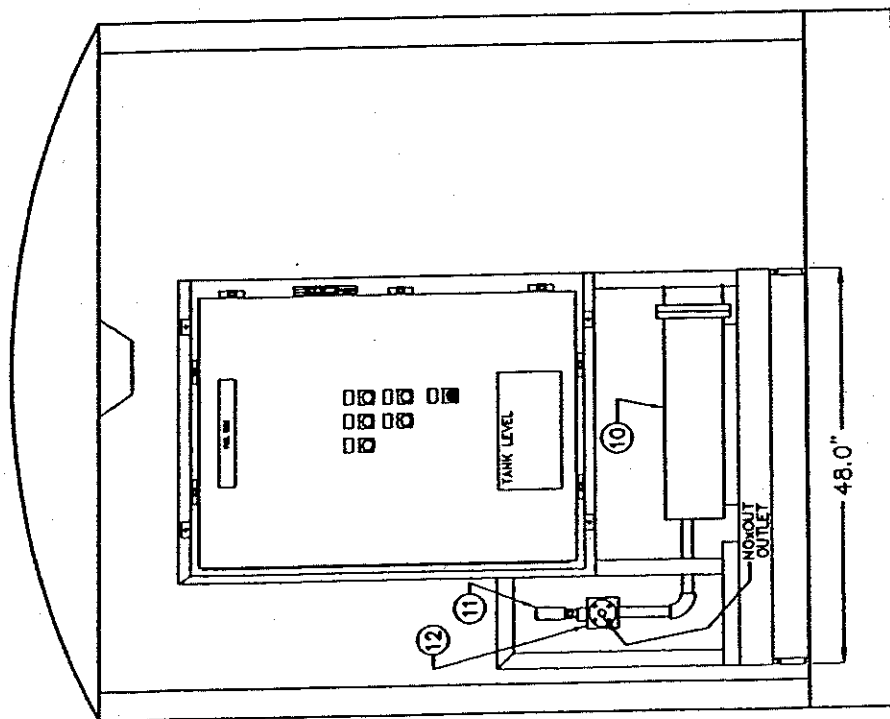
SIDE VIEW

DWG. NO.	D-1
FUEL TECH, Inc.	630-845-4900
DATE	12/16/99
312 KINGSLAND DRIVE	BATAVA, IL 60510-2399



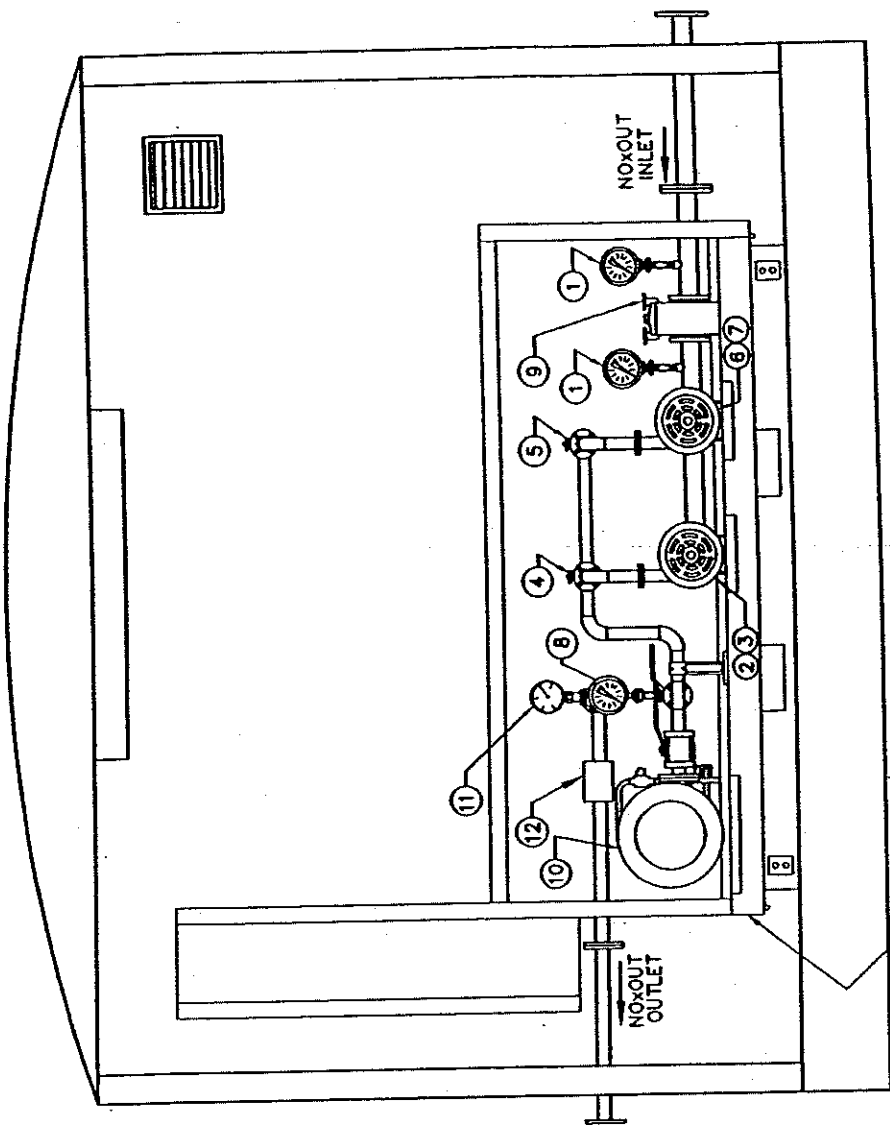
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# FUEL TECH NOXOUT SLP3 CIRCULATION MODULE & ENCLOSURE



SIDE ELEVATION  
(WALL OF ENCLOSURE  
REMOVED FOR CLARITY)


ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	PRESSURE GAUGE	7	MOTOR
2	CIRCULATION PUMP	8	PRESSURE GAUGE
3	MOTOR	9	DUPLEX STRAINER
4	BALL VALVE	10	IN-LINE HEATER
5	BALL VALVE	11	TEMPERATURE INDICATOR
6	CIRCULATION PUMP	12	FLOW ELEMENT



FRONT ELEVATION  
(WALL OF ENCLOSURE  
REMOVED FOR CLARITY)

CIRCULATION MODULE

CIRCULATION ENCLOSURE

 <b>FUEL TECH™</b> <small>Technology for a cleaner environment</small>	
QWC NO.	J-9
FUEL TECH, Inc.	630-845-4500
DATE: 12/29/99	512 KINGSLAND DRIVE, BATAVIA, IL 60510-2299

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Green River, Wyoming

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## **FUEL TECH EQUIPMENT SCOPE OF SUPPLY** ( Continued )

### **SLP3-M-ILC METERING MODULE**

This module is designed for Independent Level Control, which permits a biasing of the chemical to each injection level that is in use. The Metering Module provides flow and pressure control of the fluids used in the NOxOUT® Process, NOxOUT® A and Dilution Water. The water supply will be adjusted, via a regulator, to a set pressure that will allow for proper flow to each Distribution Module. The proper amount of NOxOUT® A is then fed, by use of a metering pump and a digital indicating controller, into the dilution water discharge line and through a static mixer. The water/boost pump is supplied to power the mixed chemical up to each injector level at the proper pressures and flow rates. The local control panel on this module can operate in local or remote. In the remote mode the plant DCS or FTI-supplied PLC can automatically feed the optimized amount of NOxOUT® A reagent water pressure through the use of a 4-20 mA signal. Automatic flush of the system is also provided to clear chemical from the lines prior to shut down.

Also includes complete assembly and testing, two (2) local control panels with PLC (NEMA 4X), two (2) SS metering pumps with DC motors and drive controllers, two (2) turbine/boost pumps with TEFC motors and motor starters, stainless steel skids with basin, two (2) static mixers, two (2) magnetic flow meters with digital indicating controllers to electronically indicate and control the precise chemical flow, two (2) magnetic flow meters, pressure control valves, pressure transmitters and indicator for controlling water flows, motor operated ball valves for chemical and water inlet, duplex strainer for water, air pressure switch, regulators for water inlet chemical calibration columns, and all necessary components, SS Schedule 40 socket-welded piping, SS butt-welded tubing, and fittings.

*Typical Size: 4'W x 10'L x 6'H – Approximate Weight: 2,400 lbs.*

**Reference FTI Drawing E-5**

### **SLP3-D-6 DISTRIBUTION MODULE**

The Distribution Modules are placed just prior to the injectors (typically at the same elevation) and are used as a guide and check for proper injector performance. Air for atomization and cooling is introduced through this module. One panel is supplied for each injector. They are grouped and pipe-manifolded together for ease of installation.

Also includes the necessary panels per module. Complete assembly and testing, flow and pressure indication with regulators for chemical and atomizing air. Each panel will be mounted to a freestanding stainless steel base and a pipe-manifold assembled for easy flow accessibility.

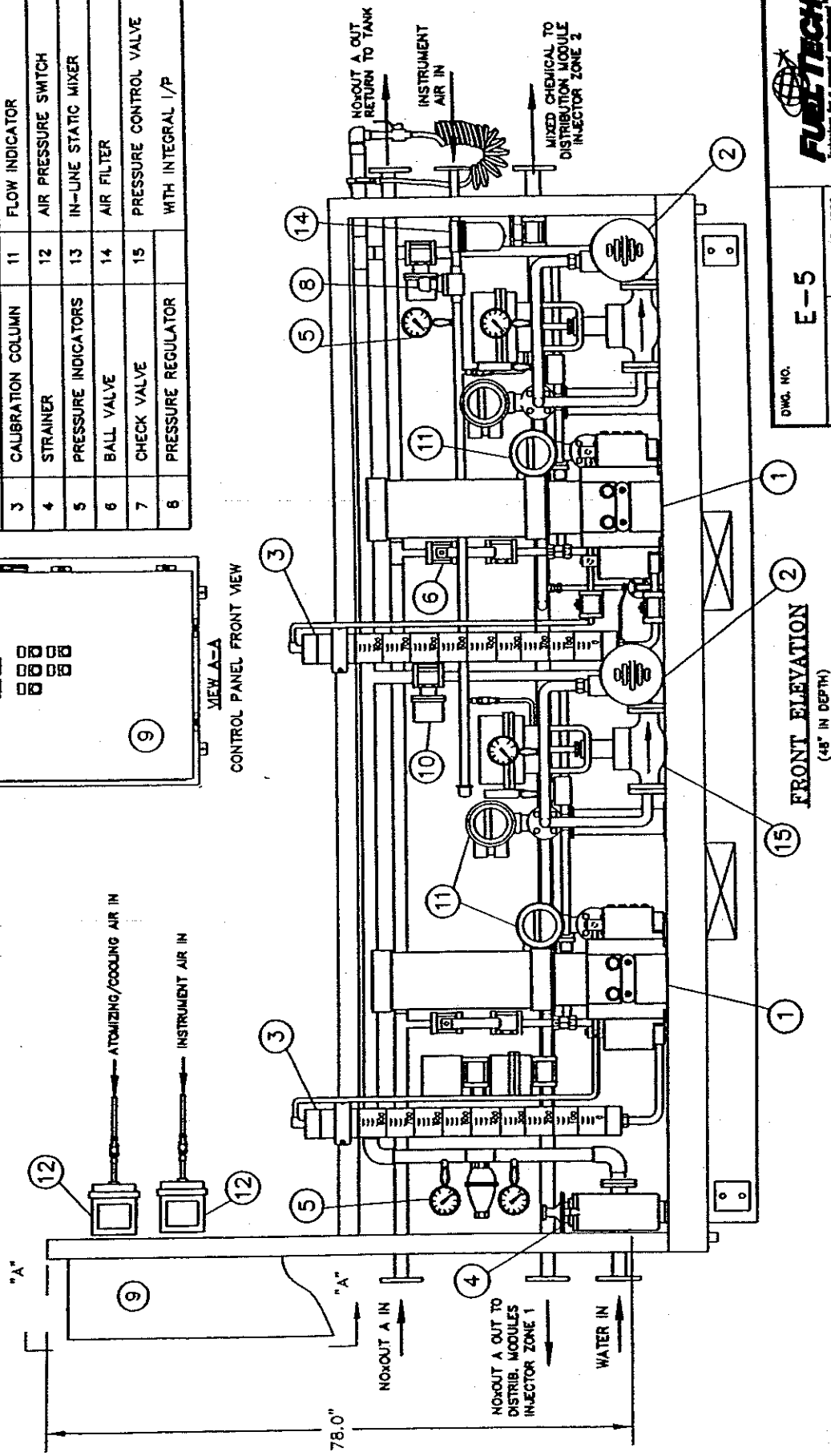
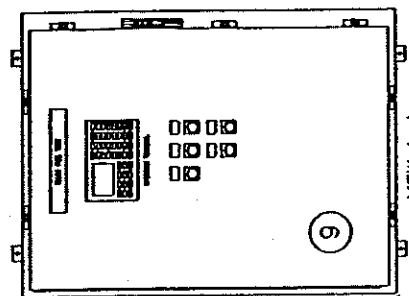
*Typical Size: (SLP3-D-4) 2'W x 4.4'L x 6'H; Approximate weight: 400 lbs.*

**Reference FTI Drawing F-2**



# METERING MODULE SLP3-M-ILC STANDARD MODULE WITH INDEPENDENT LEVEL CONTROL

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	METERING PUMP	9	CONTROL PANEL
2	WATER BOOST PUMP	10	MOTOR OP VALVE
3	CALIBRATION COLUMN	11	FLOW INDICATOR
4	STRAINER	12	AIR PRESSURE SWITCH
5	PRESSURE INDICATORS	13	IN-LINE STATIC MIXER
6	BALL VALVE	14	AIR FILTER
7	CHECK VALVE	15	PRESSURE CONTROL VALVE
8	PRESSURE REGULATOR		WITH INTEGRAL 1/2"

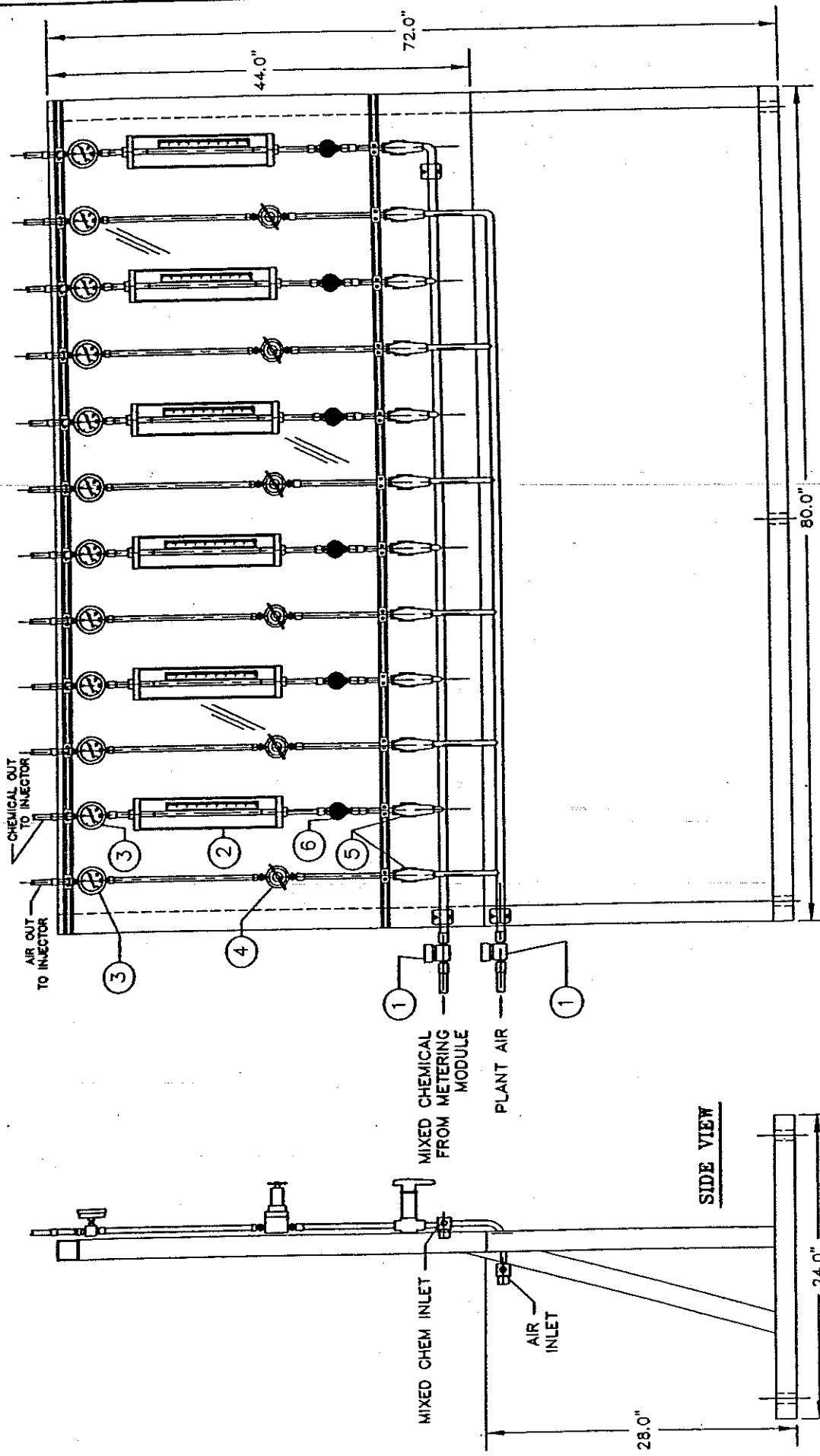


Dwg. No.
E-5

FUEL TECH, Inc.
630-845-4500
DATE: 12/20/99
512 KINGSLAND DRIVE
BATON ROUGE, LA
70801-2399

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# FUEL TECH NOxOUT SLP3-DM6 DISTRIBUTION MODULE




FRONT VIEW

ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	CHECK VALVE	4	PRESSURE REGULATOR
2	FLOW INDICATOR	5	BALL VALVES
3	PRESSURE INDICATORS	6	METERING VALVE

DWG. NO. **F-2**

FUEL TECH, Inc. 630-846-4800

DATE: 12/20/98 312 KINGSLAND DRIVE BATAVIA, IL 60103-2309



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Green River, Wyoming

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## **FUEL TECH EQUIPMENT SCOPE OF SUPPLY** ( Continued )

### **SLP3-I-FTL INJECTOR ASSEMBLY**

The urea injector assemblies are installed at the furnace elevation determined by our process modeling with each appropriately sized and characterized for proper flows and pressures required to achieve the necessary NOx reductions. The injectors are constructed entirely of 316L stainless steel. The nozzle tip is a ceramic-coated 316L stainless steel. The cooling shield is typically 3/4" Inconel tubing or 316 stainless steel with ceramic coating (.750" OD and .065" wall thickness). The inner atomization tube is typically 3/8" tubing with an adapter to accept different injector tips, with a standard length of 2.5 feet.

Each assembly includes Fuel Tech air atomized injector, adapter for insertion adjustment, coupler to attach to boiler support, quick-connects and 6' long steel-braided flex hoses for both the chemical and atomizing air connections.

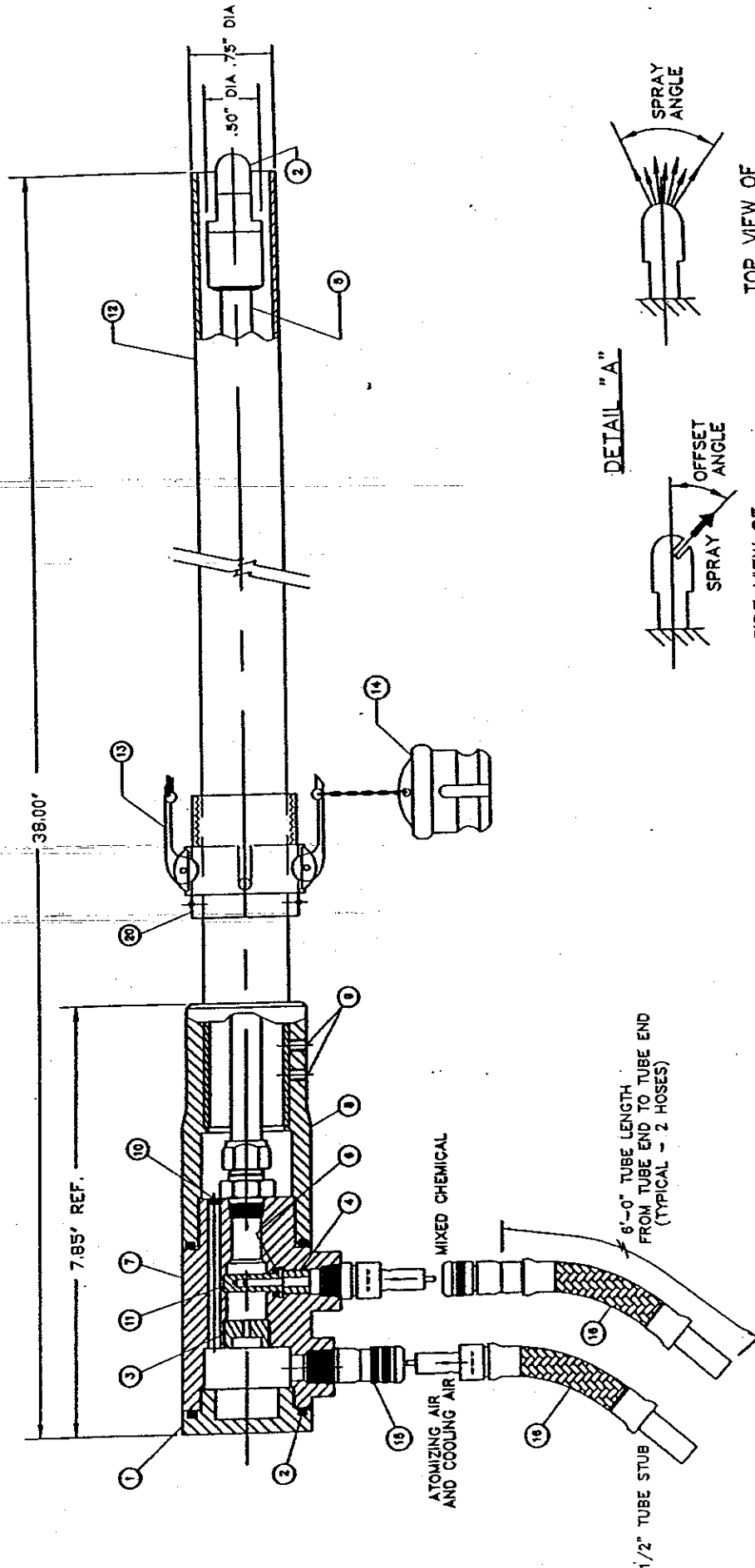
**Reference FTI Drawing G-1**

### **SLP3-AR-P AUTO RETRACT ASSEMBLYS WITH CONTROL PANELS**

This auto-retract device is an offset design and mounts on the standard/recommended 3" Sch. 40 boiler penetration. The retract is an air-over-spring device that inserts the NOxOUT® injector into the furnace when the injector is called for. When the injector starts to insert, the cooling air is shut off. With the injector fully inserted into the boiler a contact arm actuates a spool valve which allows a flow path for the NOxOUT® reagent to flow to the injector, when required, the injector will automatically retract (using only the compressed spring as the motive force if air is lost) and chemical flow will be shut-off along with fuel gas flow. Once the injector has fully inserted the front proximity switch will send an indication to the controls to let fuel gas to start to flow and then to let the mixed chemical to flow. The advantages of the retract system include; complete automation and control room indication of the NOxOUT® Injection System, system operation and chemical utilization improvement, less man-power requirements, greatly improves wear-life of the injector, insures cooling air is present when retracted, along with fuel gas being present prior to starting chemical flow.

**Reference FTI Drawing G-2**

# FUEL TECH NOXOUT SLP3 INJECTION LANCE



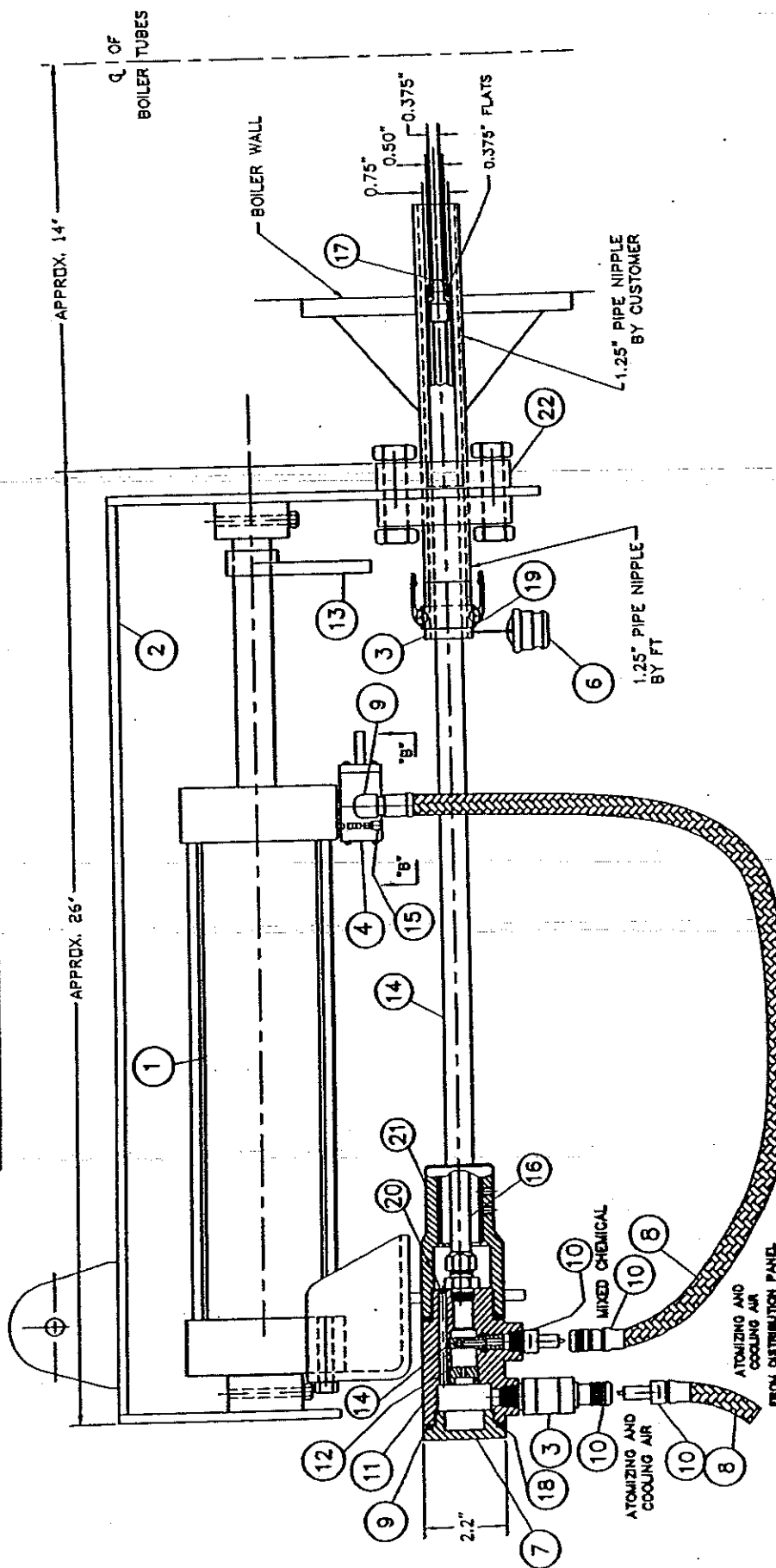
ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	CHAMBER CAP	9	SET SCREW
2	TIP-CERAMIC COATED	10	COOLING AIR SET SCREW
3	ATOMIZING AIR SET SCREW	11	LIQUID INJECTOR
4	LIQUID INJECTOR SET SCREW	12	COOLING SHIELD
5	INNER TUBE ASSEMBLY	13	1/2\" O\" COUPLER (FNPT) W/ATON GASKET
6	O-RING	14	PLUG W/SLOT
7	ATOMIZATION CHAMBER	15	QUICK DISCONNECT
8	COOLING SHIELD ADAPTOR	16	1/2\" TEE BRAIDED HOSE - 6 FEET LENGTH

SOLVAY2016\_1.3\_001426

<b>OWG. NO.</b> <b>G-1</b>	<b>FUEL TECH, Inc.</b> 630-845-4500 512 KINGSLAND DRIVE BATAVIA, IL 60510-2298
<b>DATE:</b> 12/2/98	<b>DESIGN NO.:</b> 60510-2298

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# FUEL TECH NOXOUT SLP3 INJECTION LANCE WITH AUTO RETRACT MECHANISM



ITEM	DESCRIPTION	ITEM	DESCRIPTION
1	DOUBLE ACTING SPRING RETURN CYLINDER	12	ATOMIZING AIR SET SCREW
2	AUTO RETRACT CYLINDER MOUNTING BRACKET	13	CHEMICAL VALVE ACTUATOR ARM
3	1/2" CHECK VALVE	14	COOLING SHIELD
4	1/4" 3 WAY MECHANICALLY ACTUATED VALVE	15	ALLEN HEAD CAP SCREW
5	PROXIMITY SWITCH (NOT SHOWN IN THIS VIEW)	16	INTERNAL ATOMIZATION TUBE
6	PLUG WITHOUT SLOT	17	TIP
7	INJECTOR ASSEMBLY	18	O-RING
8	4 FT FLEX HOSE W/ 1/2" TUBE STUB ENDS	19	O COUPLER
9	CHAMBER CAP	20	INTERNAL HEX SOCKET METERING ORIFICE
10	1/2" QUICK CONNECT (VALVED)	21	COOLING SHIELD ADAPTER
11	ATOMIZATION CHAMBER	22	1.25" Ø MOUNTING FLANGE (1 PAIR)

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DWG. NO.	G-2
FUEL TECH, Inc.	630-845-4600
DATE: 12/2/99	512 KINGSLAND DRIVE BATON Rouge, LA 70810-2296

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Green River, Wyoming

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## **FUEL TECH EQUIPMENT SCOPE OF SUPPLY** ( Continued )

### **TEMPERATURE MONITORING SYSTEM**

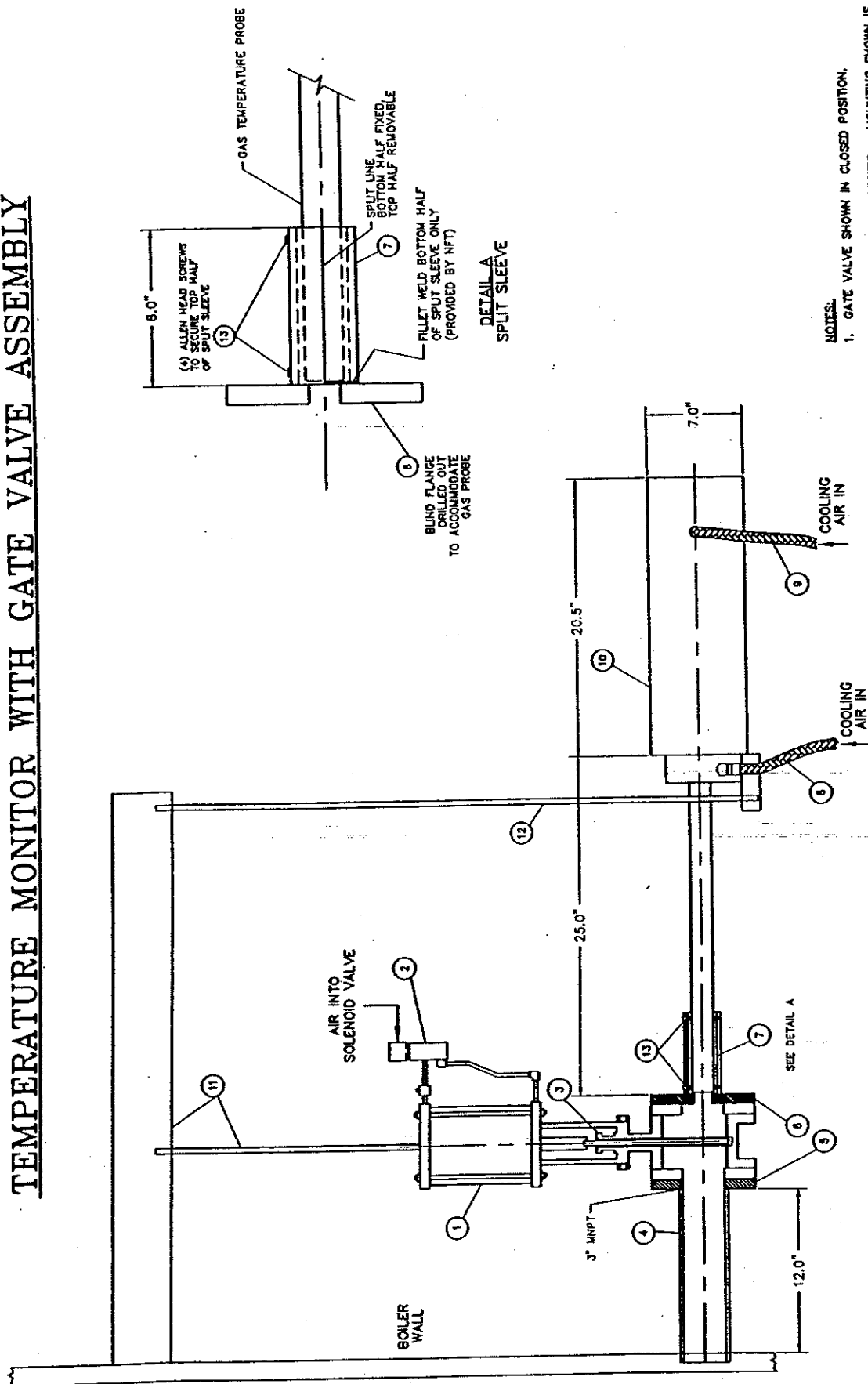
The temperature monitoring system supplied by Fuel Tech is an optical pyrometer designed to continuously monitor the furnace flue gas temperature. The temperature monitor senses the visible light from the ash particles to determine the flue gas temperature. Temperature readings are not biased by unit wall temperatures and can provide temperature readings for units firing coal, wood waste, municipal solid waste, refuse derived fuels, heavy oil or any other fuel which produce glowing particles during combustion.

The temperature sensed by the monitor will be utilized in determining the proper zone of injection for the NOxOUT® process. By properly selecting the zone of injection based on flue gas temperature, the NOxOUT® process can be optimized with regard to NOx reduction, chemical flows, and ammonia slip. This temperature control signal allows the Fuel Tech engineers to optimize the system operation and provide the best available SNCR system. The temperature monitor will require the following utilities and connections in order to be installed and operate properly:

- 3" threaded pipe nipple extending 4-6 inches outside the boiler wall
- 110 VAC power
- 60 to 80 psig plant air
- Structural support of the unit (approximately 100 lbs)

**Reference FTI Drawings G-15 and G-11**

# TEMPERATURE MONITOR WITH GATE VALVE ASSEMBLY



## NOTES:

1. GATE VALVE SHOWN IN CLOSED POSITION.
2. MOUNTING IS SITE SPECIFIC. MOUNTING SHOWN IS FOR EXAMPLE PURPOSES ONLY.

DWG. NO.

G-15

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Technology for a warmer tomorrow

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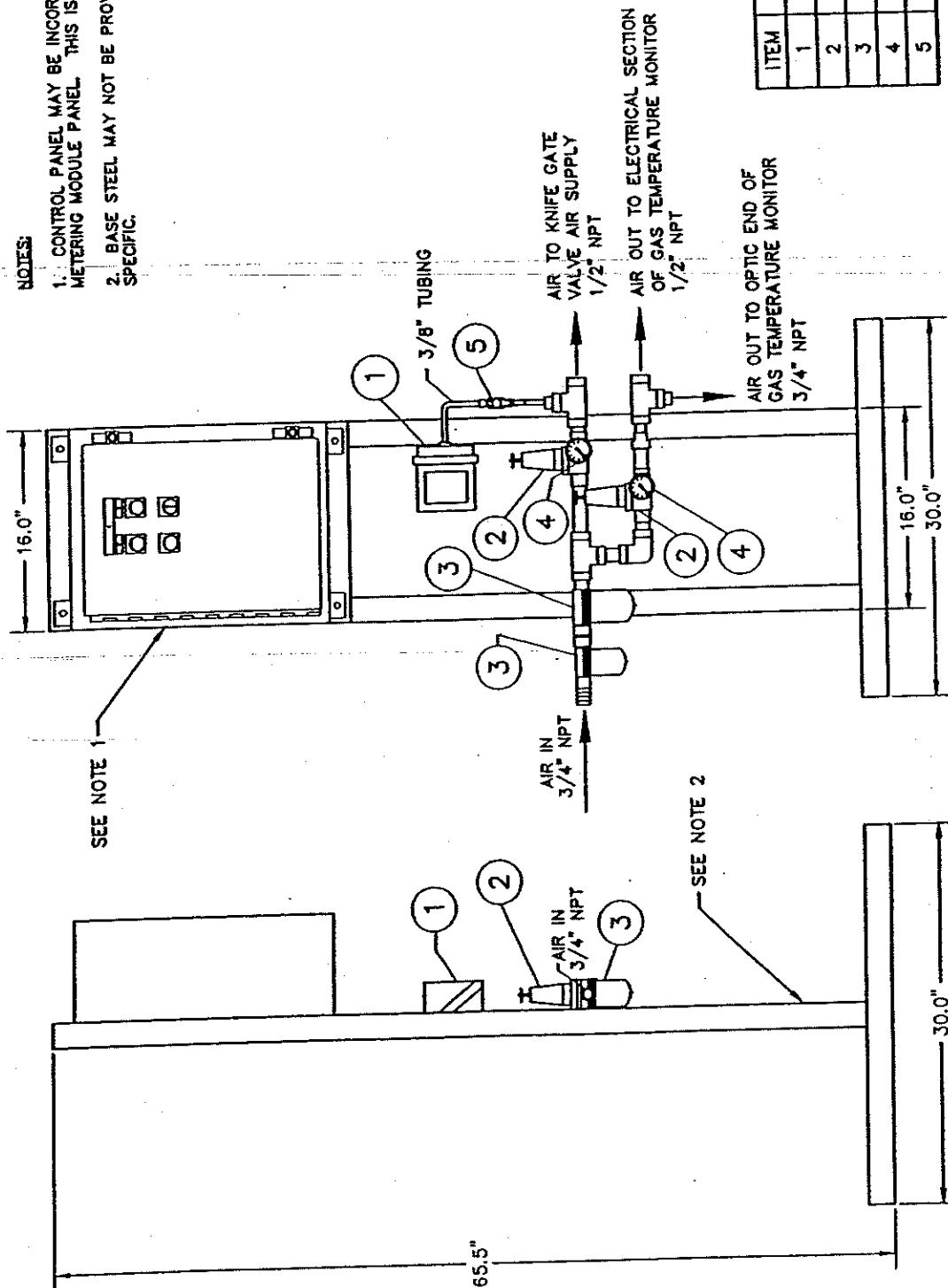
DATE: 12/8/99 512 KINGSLAND DRIVE BATAVIA, IL 60510-2289

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
1	3" GATE VALVE WITH SPRING RETURN CYLINDER	1	7	SPLIT SLEEVE	1
2	W/ OPTIONAL CHEST BUTTONS	2	8	48" LENGTH - 3/4" S.S. BRAIDED FLEXHOSE	1
3	2 POSITION SOLENOID VALVE	1	9	48" LENGTH - 1/2" S.S. BRAIDED FLEXHOSE	1
4	3" PIPE NIPPLE	2	10	GAS TEMPERATURE PROBE	1
5	3" 150# RF FLANGE	1	11	SUPPORT ASSEMBLY FOR GATE VALVE	1
6	3" 150# BLIND FLANGE (BORED TO 1-1/4")	1	12	ADJUSTABLE SUPPORT ROD	2
			13	ALLEN HEAD SCREWS	4

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# NOxOUT-U TEMPERATURE MONITOR

- NOTES:
1. CONTROL PANEL MAY BE INCORPORATED INTO METERING MODULE PANEL. THIS IS SITE SPECIFIC.
  2. BASE STEEL MAY NOT BE PROVIDED. THIS IS SITE SPECIFIC.



ITEM	DESCRIPTION
1	PRESSURE SWITCH
2	PRESSURE REGULATOR
3	FILTER
4	PRESSURE INDICATOR
5	PLUG VALVE

DWG. NO.	G-11
FUEL TECH, Inc.	830-845-4800
DATE: 12/2/99	512 KINGSLAND DRIVE BATAVIA, IL 60810-2399



FRONT ELEVATION

SIDE VIEW

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## **FUEL TECH SCOPE OF SUPPLY** ( Continued )

### **CONTROL ROOM COMPUTER INTERFACE**

The Control Room Computer Interface System is a man-machine interface (MMI) that allows control, monitoring, and trending of the Fuel Tech, Inc. NO<sub>x</sub>OUT® Equipment from the customer's control room. The System utilizes an Allen Bradley RSView Development Package and operates on an IBM compatible, Pentium based computer and enables the operator to communicate with the Master Control Module (Metering Module) via Allen Bradley Data Highway Plus communication link for real-time control, indication, and trending. The software system is designed in a Windows based format and utilizes 5-10 real-time interactive screens depending on the complexity of the Fuel Tech, Inc. System. The system includes the following features:

- Limited On-line Control Functions
- On-Line Relational Database for Trending.
- Data Logging and Report Generation.
- Interactive Color Graphics.
- Multiple Color Graphic Monitor.
- Mouse and Keyboard Inputs.
- Alarm Monitoring, Supervision, and Logging.
- Math and Logic Functions.

The Control Room Computer System Interface includes: Computer hardware configuration and programming, Pentium based Computer, Data Highway Plus Communication, and Software programming.

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Green River, Wyoming

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## **FUEL TECH SCOPE OF SUPPLY** ( Continued )

### **ENGINEERING:**

Fuel Tech will provide Project and Process Engineering and the following drawings and information:

- P&IDs
- Skid Arrangements
- Foundation Loads
- Interface Drawings
- Injector Locations
- Electrical Drawings and Bill of Materials
- Pump Performance Curves

### **ENGINEERING SERVICES:**

- Computational Fluid Dynamics and Chemical Kinetic Modeling
- Project Engineering
- Installation Support, Start-up and Optimization Services
  - 30 Man-days Per Unit for SNCR Options
- Operation and Maintenance Manuals (5)

### **Note:**

Specified items, listed below, contained in Solvay Chemicals Request For Quote (RFQ #104193) Dated 11/15/04, are included as Engineering Services.

Items: 1(i), 1(iv), 1(vii), 2, 4, 5, 6 (see Clarifications), 8, 9, 11, 12 thru 17, 21, 26, 27, 28, 29, 32, 33 (see Clarifications), 34 thru 50.

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Green River, Wyoming

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### SCOPE OF SUPPLY BY OTHERS

1. Installation of Fuel Tech, Inc. Supplied Equipment.
2. Interconnecting Piping and Wiring of Fuel Tech, Inc. Supplied Equipment.
3. Demolition of Existing Equipment – Including but not Limited to Ductwork, Hangers, Structural Steel, Expansion Joints, Dampers, Foundations, etc.
4. Tank Foundation and Structural Support for System Modules.
5. Auxiliary Power (480V/3/60) and Control Power (110V).
6. Atomizing Air for Reagent (8-10 scfm per wall injector @ 60-80 psig).
7. Condensate Loop Cooling Water for Multiple Nozzle Lances (~ 40 gpm @ 100°F per Multiple Nozzle Lance).
8. Instrument Air (minimal).
9. Dilution Water: Service Water Quality (~ 1gpm per injector).
10. Chemical Supply: NOxOUT® A Quality Licensed Reagent (50% Solution).
11. Implement Control Logic Schemes into Plant Control Schemes.
12. NOx, Ammonia, and CO Monitoring Equipment, If Required.
13. Required Boiler Tube Panes for Injector Wall Sleeves and Mounting.
14. System Performance Testing.
15. Spare Parts.
16. Specified Items, Listed Below, Contained in Solvay Chemicals Request For Quote (RFQ #104193) Dated 11/15/04 – Please Note That Fuel Tech, Inc. Considers These Activities Best Suited In Balance Of Plant Engineering Scope Of Supply. Fuel Tech, Inc. Is Capable Of Providing These Services; However, They Are Not Included In This Proposal At This Time.

Items: 1(ii), 1(iii), 3, 7 (see Clarifications), 10, 20, 23.

Solvay Minerals  
Coal Calciner  
Green River, Wyoming

November 30, 2004  
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## **PRICING and TERMS OF PAYMENT**

For the Engineering, Equipment and Services identified in this proposal, we quote the firm price of:

**ONE MILLION TWO HUNDRED NINETY THREE THOUSAND DOLLARS**  
**( \$1,293,000.00 )**

The above Project Price Breakouts for Accounting purposes are as follows:

Engineering Price:	\$255,000.00
Equipment Price:	\$897,000.00
Start-up Services and Installation Support	\$141,000.00
(Includes Thirty (30) Mandays for Start-up, Optimization and Training and Twenty (20) Mandays for Installation Support/Supervision.)	

Price includes Thirty (30) Mandays of Start-up Supervision and Optimization Services per Unit with Living and Travel Expenses included.

Prices are FOB point of destination. Installation shall be By Others. Price is valid for sixty (60) days from the date of this proposal.

Fuel Tech's proposed Terms of Payment are provided below and our Standard Terms and Conditions, identified as Exhibit C3, are included on the following pages.

### **TERMS OF PAYMENT**

- 10% Upon receipt of Letter of Intent, Purchase Order, or Contract
- 20% Upon submittal of Drawings to the Buyer for Approval
- 20% Upon Buyer's release for equipment fabrication
- 10% Upon submittal of Certified Drawings to the Buyer
- 30% Upon date of shipment of equipment, or thirty days after notification to buyer that equipment is ready to ship, whichever occurs first.
- 10% After successful completion of acceptance test or six (6) months after receipt of equipment, whichever occurs first.

All invoices are payable Net 30 Days. Buyer shall pay interest at the rate of ten percent (10%) per annum on all overdue amounts. Buyer shall pay all sales tax, use tax, excise tax, or other similar taxes.

Solvay Minerals  
Coal Calciner  
Green River, Wyoming

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**EXHIBIT C3**  
**FUEL TECH, INC. STANDARD TERMS AND CONDITIONS**

These terms and conditions shall be part of the attached proposal and shall become part of the contract entered into between FUEL TECH, INC. (Fuel Tech), and the Buyer. Deviations from these terms and conditions must be agreed to in a writing signed by Fuel Tech and the Buyer. Fuel Tech hereby gives notice of its objection to any different or additional terms or conditions unless such different or additional terms or conditions are agreed to in a writing signed by Fuel Tech and Buyer.

**1. TERMS OF PAYMENT:**

All invoices are payable net thirty (30) days from date of invoice. Buyer shall pay interest at the rate of ten percent (10%) per annum on all overdue amounts. Buyer shall pay all sales tax, use tax, excise tax, or other similar taxes.

**2. DELAYS:**

If shipments are delayed by Buyer, payment shall be due on and warranty coverage shall begin to run from thirty days after the original shipment date specified in the contract or thirty (30) days after notification to Buyer that equipment is ready to ship, whichever is earlier. Risk of loss shall pass to Buyer at the time that equipment is identified, and any costs caused by such delay shall be borne by Buyer.

If shipments are delayed by Buyer, Fuel Tech will ship the equipment no later than sixty (60) days after initial notification to the Buyer that the equipment is ready for shipment. Buyer agrees either (1) to provide Fuel Tech an appropriate "ship to" address and to accept delivery or (2) pay reasonable storage charges for the equipment beginning sixty (60) days after initial notification to Buyer that equipment is ready to ship.

**3. PERFORMANCE GUARANTEE:**

Buyer warrants that the operating conditions of the Unit are those specified in the Process Design Table. Buyer is solely responsible for the accuracy of that operating condition information, and all performance guarantees and equipment warranties granted by Fuel Tech shall be void if that operating condition information is inaccurate or is not met. All performance guarantees and equipment warranties are conditioned on Buyer timely providing all of the equipment, materials, chemicals, utilities, and services that it has agreed to provide, on operating the Unit within the operating conditions specified in the Process Design Table, and on using reagent of license grade quality in the operation of the Unit.

**4. EQUIPMENT WARRANTY:**

Fuel Tech warrants that the equipment it provides shall be free from defects in design, workmanship, and material at the time the equipment is delivered and for a period of twelve (12) months after initial operation, or eighteen (18) months from shipment of equipment, whichever occurs first. Fuel Tech does not warrant wear parts such as injection tips, cooling shields, pump diaphragms, check valves, solenoids, pump impellers, pump wear rings, pump seals, valve packing, and valve seats.

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All warranties made by the manufacturer of the equipment (if that manufacturer is any entity other than Fuel Tech) shall be assigned by Fuel Tech to the Buyer, if such assignment is permissible by law and contract. Warranty coverage starts at shipment of equipment or thirty (30) days after notification to Buyer that equipment is ready to ship.

5. **DISCLAIMER OF WARRANTIES:**

Fuel Tech warrants its equipment and the performance of its equipment solely in accordance with the equipment warranty and performance guarantee contained in this proposal and makes no other representations or warranties of any other kind, express or implied, by fact or by law. All warranties other than those specifically set forth in this proposal are expressly disclaimed. **FUEL TECH SPECIFICALLY DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, AND DISCLAIMS THE IMPLIED WARRANTY OF MERCHANTABILITY, THE IMPLIED WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE, AND ANY OTHER IMPLIED WARRANTIES OF DESIGN, CAPACITY, OR PERFORMANCE RELATING TO THE EQUIPMENT.**

6. **LIMITATION OF LIABILITY:**

Buyer's sole remedy under the equipment warranty and the performance guarantee shall be to allow Fuel Tech, at Fuel Tech's option, either to repair, replace, or supplement the equipment to meet the performance guarantee, or, in the event that those options are not feasible, to remove the Equipment and refund the contract price to Buyer. **NOTWITHSTANDING ANYTHING TO THE CONTRARY, FUEL TECH'S TOTAL LIMIT OF LIABILITY ON ANY CLAIM, WHETHER FOR BREACH OF CONTRACT, BREACH OF WARRANTY, TORT, NEGLIGENCE, STRICT LIABILITY, OR ANY OTHER LEGAL THEORY, FOR ANY LOSS OR DAMAGE ARISING OUT OF, OR CONNECTED TO, OR RESULTING FROM THIS AGREEMENT, INCLUDING WITHOUT LIMITATION AMOUNTS INCURRED BY FUEL TECH OR BUYER IN ATTEMPTING TO REPAIR, REPLACE, OR SUPPLEMENT THE EQUIPMENT OR MEET THE PERFORMANCE GUARANTEE, SHALL BE LIMITED TO THE CONTRACT PRICE TO BE PAID BY BUYER PURSUANT TO THE CONTRACT.**

7. **EXCLUSION OF CONSEQUENTIAL DAMAGES:**

**NOTWITHSTANDING ANYTHING TO THE CONTRARY, IN NO EVENT SHALL FUEL TECH BE LIABLE FOR ANY INDIRECT, CONSEQUENTIAL, INCIDENTAL, SPECIAL, OR PUNITIVE DAMAGES, INCLUDING BUT NOT LIMITED TO LOSS OF CAPITAL, LOSS OF REVENUES, LOSS OF PROFITS, LOSS OF ANTICIPATORY PROFITS, LOSS OF BUSINESS OPPORTUNITY, DAMAGE TO EQUIPMENT OR FACILITIES, COST OF SUBSTITUTE NOx REDUCTION SYSTEMS, DOWNTIME COSTS, GOVERNMENT FINES, OR CLAIMS OF CUSTOMERS, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.**

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**8. RESPONSIBILITY FOR THIRD PARTIES**

Buyer shall at all times be responsible for the acts and omissions of its subcontractors and of any other third parties hired or retained or contracted by Buyer to perform work or provide equipment related to the system provided by Fuel Tech, including but not limited to third party design, systems integration, equipment tie-in, or process design changes. Fuel Tech shall have no responsibility for ensuring the accuracy of any such work or the performance of any equipment provided by subcontractors or third parties hired or retained or contracted by Buyer, and Buyer assumes all liability for any such work or equipment and for any failures in Fuel Tech's equipment caused by any such subcontractors or third parties hired or retained or contracted by Buyer. Buyer agrees to indemnify, hold harmless, and defend Fuel Tech from any claims, losses, damages, injuries, or failures caused by any such subcontractors or third parties.

**9. CONFIDENTIALITY:**

Buyer agrees that it shall hold Confidential Information received from Fuel Tech in the strictest confidence, shall not use the Confidential Information for its own benefit except as necessary to fulfill the terms of the agreement between the parties, shall disclose the Confidential Information only to employees, agents, or representatives who have a need to know the Confidential Information, shall not disclose the Confidential Information to any third party, shall not copy the Confidential Information, shall not disassemble, decompile, or otherwise reverse engineer the Confidential Information and any inventions, processes, or products disclosed by Fuel Tech, and, in preventing disclosure of Confidential Information to third parties, shall use the same degree of care as for its own information of similar importance, but no less than reasonable care.

**10. LICENSE AGREEMENT AND OTHER TERMS:**

Sale is subject to agreement on other terms and conditions, including a Sale of Equipment with License Agreement.

**11. INDEMNIFICATION:**

Each Party shall defend, indemnify, and hold harmless the other Party and its employees, agents, and representatives from any claims, liabilities, lawsuits, costs, losses, or damages that arise out of or result from any negligent or willful acts or omissions of the indemnifying Party's employees, agents, or representatives. Where such claims, liabilities, lawsuits, costs, losses, or damages are the result of the joint or concurrent negligence or willful misconduct of the Parties or their respective agents, employees, representatives, subcontractors, or any third party, each Party's duty of indemnification shall be in the same proportion that the negligence or willful misconduct of such Party, its agents, employees, representatives, or subcontractors contributed thereto. The Party entitled to indemnity under this Agreement shall promptly notify the indemnifying Party of any indemnifiable claim, liability, lawsuit, cost,

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loss, or damage. The Party responsible for indemnification under this Agreement shall conduct and control the defense of the indemnified claim, liability, lawsuit, cost, loss, or damage. The Parties shall use their best efforts to cooperate in all aspects of the defense of any such claim, liability, lawsuit, cost, loss, or damage. The indemnifying Party shall not be bound by any compromise or settlement made without its prior written consent.

**12. FORCE MAJEURE**

The Parties shall be excused from liability for delays in manufacture, delivery, or performance due to any events beyond the reasonable control of the Parties, including but not limited to acts of God, war, national defense requirements, riot, sabotage, governmental law, ordinance, rule, or regulation (whether valid or invalid), orders of injunction, explosion, strikes, concerted acts of workers, fire, flood, storm, failure of or accidents involving either Party's plant, or shortage of or inability to obtain necessary labor, raw materials, or transportation ("Force Majeure"). Any delay in the performance by either party under this Agreement shall be excused if and to the extent the delay is caused by the occurrence of a Force Majeure, provided that the affected party shall promptly give written notice to the other party of the occurrence of a Force Majeure, specifying the nature of the delay, and the probable extent of the delay, if determinable.

Following the receipt of any written notice of the occurrence of a Force Majeure, the parties shall immediately attempt to determine what fair and reasonable extension for the time of performance may be necessary. The parties agree to use reasonable commercial efforts to mitigate the effects of events of Force Majeure.

No liabilities of any party that arose before the occurrence of the Force Majeure event shall be excused except to the extent affected by such subsequent Force Majeure.

**13. GOVERNING LAW**

This Agreement shall be governed by and interpreted in accordance with the laws of the State of Illinois, excluding its choice of laws rules. The parties shall attempt to settle any disputes, controversies, or claims arising out of this Agreement through consultation and negotiation in good faith and in a spirit of mutual cooperation. If those attempts fail, then any dispute, controversy or claim shall be submitted first to a mutually acceptable neutral advisor for mediation. Neither party may unreasonably withhold acceptance of a neutral advisor. The selection of the neutral advisor must be made within forty-five (45) days after written notice by one party demanding mediation, and the mediation must be held within six months after the initial demand for it. By mutual agreement, however, the parties may postpone mediation until they have each completed some specified but limited discovery about the dispute, controversy, or claim. The cost of mediation shall be equally shared between the parties. Any dispute that the parties cannot resolve through mediation within



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six (6) months after the initial demand for it may then be submitted to a state or federal court of competent jurisdiction within the State of Illinois for resolution. The use of mediation shall not be construed (under such doctrines as laches, waiver, or estoppel) to have adversely affected any party's ability to pursue its legal remedies, and nothing in this provision shall prevent any party from resorting to judicial proceedings if good faith efforts to resolve a dispute under these procedures have been unsuccessful or interim resort to a court is necessary to prevent serious and irreparable injury to any party or others.

14. **ENTIRE AGREEMENT**

This Exhibit C3 and the Fuel Tech Proposal attached to it constitute the entire agreement between the parties and can be modified only in writing signed by authorized representatives of each of the parties.

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### TYPICAL PROJECT SCHEDULE

EVENT	RESPONSIBILITY	WEEKS FROM ORDER DATE
Receipt of Order	CUSTOMER	0
Project Kick-Off Meeting	JOINT	1
Begin Equipment Design	FUEL TECH	2
Submit Preliminary Equipment Drawings <sup>1</sup>	FUEL TECH	4
Submit Equipment Drawings For Approval	FUEL TECH	9
Customer Drawing Comments Received	CUSTOMER	12
Begin Equipment Fabrication	FUEL TECH	16
Equipment Shipment	FUEL TECH	26
Equipment Delivery	FUEL TECH	28
Complete Equipment Installation	CUSTOMER	TBD
Begin Start-Up and Testing	FUEL TECH	1-2 Weeks After Completion of Installation
Begin System Optimization	FUEL TECH	2-6 weeks
Compliance Testing	CUSTOMER	TBD

<sup>1</sup> General Arrangement and Piping & Instrumentation Diagrams.

Schedule is projected based on existing project commitments and anticipated workload and may be considered typical for the system proposed. This schedule is based on the Customer having provided Fuel Tech all relevant design information. Drawing review is based on three (3) weeks turnaround.

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## EXCEPTIONS and CLARIFICATIONS

### SPECIFICATION ITEMS:

6. Fuel Tech, Inc. will provide drawings identifying shipping weight and dimensions. Lifting locations, center of gravity, support requirements, etc. shall be By Others.
7. Fuel Tech, Inc. will provide drawings identifying shipping weight and dimensions. Balance of Requirements By Others.
10. Preparation of detailed design drawings for installation By Others at this time.
19. SNCR System not designed for Slag Control.
30. The SNCR System is designed for guaranteed performance at load conditions listed in our Process Design Table. Fuel Tech, Inc. understands this Unit will be base-loaded.
36. Cost of Report is included in Base Price.
38. Cost of Attendance is included in Base Price.
40. Cost of Reports are included in Base Price.
44. Cost of Inspection included in Base Price.
45. Cost of Inspection included in Base Price.
50. Cost of Inspection included in Base Price.



## PRODUCT BULLETIN

# NOxOUT® A

## NOx Emission Control

### PRODUCT BENEFITS

Fuel Tech NOxOUT® A helps to safely and economically reduce NOx (nitrogen oxides) emissions from the combustion of fossil and waste-derived fuels when applied with custom-designed feed equipment. NOxOUT® A helps combustion sources meet federal, state, and local air quality standards. The product does not require special handling since it is non-hazardous under SARA, Title III regulations.

Secondary emission problems of ammonia slip as a by-product can be reduced or prevented with the use of NOxOUT® A. The strict manufacturing standards and proprietary ingredients help to prevent scaling of the feed system and thus allow the consistent feed of chemical to assist the control of NOx emissions.

### PRINCIPAL USES

NOxOUT® A is used to remove up to 80% NOx as part of the patented NOxOUT® Process, a selective non-catalytic removal system. The product ingredients react with NOx to form non-detrimental  $N_2$ ,  $H_2O$ , and  $CO_2$  in the wide application temperature range of 1600 to 2100°F.

### DESCRIPTION

NOxOUT® A is a liquid blend of urea and proprietary ingredients which meets exacting quality control specifications. For typical physical properties and specific safety information, refer to the Material Safety Data Sheet available from Fuel Tech.

### FEEDING

The product is delivered in concentrated form and is diluted with plant water to aid in atomization and distribution in the combustion unit. NOxOUT® A is injected after the combustion zone with customized feed equipment for proper atomization at a location where maximum contact with NOx can be made in the appropriate temperature zone. Contact with copper and copper alloys should be avoided.

### STORAGE

In storage, the product temperature should be maintained above 60°F; if lower temperatures are reached, the neat product should be warmed to 70°F and the product mixed to make it homogeneous.

### SHIPPING

Fuel Tech NOxOUT® is available from licensed regional suppliers in bulk quantities. Contact your local Fuel Tech representative for a list of suppliers serving your area.

### EMERGENCIES

For Medical and Transportation Emergencies involving NOxOUT® A, call CHEMTREC at 1.800.424.9300.





## MATERIAL SAFETY DATA SHEET

### PRODUCT

**NOxOUT® A**

Emergency Telephone Number

CHEMTREC - 1.800.424.9300 (24 hours)

### SECTION 1 - PRODUCT IDENTIFICATION

Trade Name: NOxOUT® A

Description: An aqueous solution of an amide

NFPA 704M/HMIS Rating: 1/1 Health 0/0 Flammability 0/0 Reactivity 0/Other

0=Insignificant 1=Slight 2=Moderate 3=High 4=Extreme

### SECTION 2 - COMPOSITION / INGREDIENT INFORMATION

Our hazard evaluation of the ingredient(s) under OSHA's Hazard Communication Rule, 29 CFR 1910.1200 has found none of the ingredient(s) hazardous.

### SECTION 3 - HAZARD IDENTIFICATION

#### EMERGENCY OVERVIEW:

**Caution:** May cause irritation to skin and eyes. Avoid contact with skin, eyes, and clothing. Avoid prolonged or repeated breathing of vapor. Use with adequate ventilation. Do not take internally.

Empty containers may contain residual product. Do not reuse container unless properly reconditioned.

Primary Route(s) of Exposure: Eye, Skin, Inhalation

**Eye Contact:** Can cause mild, short-lasting irritation.

**Skin Contact:** May cause irritation with prolonged contact.

**Inhalation:** May cause irritation to the respiratory tract and lungs.

#### SYMPTOMS OF EXPOSURE:

A review of available data does not identify any symptoms from exposure not previously mentioned.

**Aggravation of Existing Conditions:** A review of available data does not identify any worsening of existing conditions.

### SECTION 4 - FIRST AID INFORMATION

**Eyes:** Flush with water for 15 minutes. Call a physician.

**Skin:** Wash thoroughly with soap and rinse with water. Call a physician.

**Ingestion:** Do not induce vomiting. Give water. Call a physician.

**Inhalation:** Remove to fresh air. Treat symptoms. Call a physician.

**Note To Physician:** Based on the individual reactions of the patient, the physician's judgment should be used to control symptoms and clinical condition.

**Caution:** If unconscious, having trouble breathing or in convulsions, do not induce vomiting or give water.

### SECTION 5 - FIRE FIGHTING

**Flash Point:** None

**Extinguishing Media:** This product would not be expected to burn unless all the water is boiled away. The remaining organics may be ignitable. Use water to cool containers exposed to fire.

**Unusual Fire and Explosion Hazard:** May evolve CO, CO<sub>2</sub>, NO<sub>x</sub>, ammonia, and cyanuric acid under fire conditions.



## MATERIAL SAFETY DATA SHEET

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**NOxOUT® A**

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CHEMTREC - 1.800.424.9300 (24 hours)

### SECTION 6 - ACCIDENTAL RELEASE MEASURES

In case of transportation accidents, call the following 24-hour telephone number: 1.800.424.9300 (CHEMTREC).

#### SPILL CONTROL AND RECOVERY:

**Small Liquid Spills:** Contain with absorbent material, such as clay, soil or any commercially available absorbent. Shovel reclaimed liquid and absorbent into recovery or salvage drums for disposal. Refer to CERCLA in Section 15.

**Large Liquid Spills:** Dike to prevent further movement and reclaim into recovery or salvage drums or tank truck for disposal. Refer to CERCLA in Section 15.

### SECTION 7 - HANDLING AND STORAGE

**Storage:** Keep container closed when not in use.

### SECTION 8 - EXPOSURE CONTROLS / PERSONAL PROTECTION

**Respiratory Protection:** Respiratory protection not normally needed. If significant dusting occurs, wear a NIOSH approved or equivalent dust respirator.

For large spills, entry into large tanks, vessels or enclosed small spaces with inadequate ventilation, a positive pressure, self-contained breathing apparatus is recommended.

**Ventilation:** General ventilation is recommended.

**Protective Equipment:** Use impermeable gloves and chemical splash goggles when attaching feeding equipment, doing maintenance or handling product. Examples of impermeable gloves available on the market are neoprene, nitrile, PVC, natural rubber, viton and butyl (compatibility studies havenot been performed).

The availability of an eye wash fountain and safety shower is recommended.

If clothing is contaminated, remove clothing and thoroughly wash the affected area. Launder contaminated clothing before reuse.

**Human Exposure Characterization:** Based on Fuel Tech's recommended product application and our recommended personal protective equipment, the potential human exposure is: LOW.

### SECTION 9 - PHYSICAL AND CHEMICAL PROPERTIES

Color:	Clear golden	
Form:	Liquid	
Density:	9.5 lbs/gal.	
Specific Gravity:	1.14 @ 77 Degrees F	ASTM D-1298
Ph (NEAT) =	9.5	ASTM E-70
Viscosity:	4 cps @ 72 Degrees F	ASTM D-2983
Flash Point:	None	
Crystallization Point:	60 Degrees F	

Note: These physical properties are typical values for this product.



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CHEMTREC - 1.800.424.9300 (24 hours)

### SECTION 10 - STABILITY AND REACTIVITY

**Incompatibility:** Avoid contact with strong oxidizers (eg. chlorine, peroxides, chromates, nitric acid, perchlorates, concentrated oxygen, permanganates) which can generate heat, fires, explosions and the release of toxic fumes.

**Thermal Decomposition Products:** In the event of combustion CO, CO<sub>2</sub>, NO<sub>x</sub>, ammonia, and cyanuric acid may be formed. Do not breathe smoke or fumes. Wear suitable protective equipment.

### SECTION 11 - TOXICOLOGICAL INFORMATION

**Toxicity Studies:** No toxicity studies have been conducted on this product.

**Human Hazard Characterization:** Based on our hazard characterization, the potential human hazard is: **LOW**

### SECTION 12 - ECOLOGICAL INFORMATION

If released into the environment, see CERCLA in Section 15.

**Environmental Hazard and Exposure Characterization:** Based on our Hazard Characterization, the potential environmental hazard is: **MODERATE**. Based on Fuel Tech's recommended product application and the product's characteristics, the potential environmental exposure is: **LOW**.

### SECTION 13 - DISPOSAL CONSIDERATIONS

**Disposal:** If this product becomes a waste, it does not meet the criteria of a hazardous waste as defined under the Resource Conservation and Recovery Act (RCRA) 40 CFR 261, since it does not have the characteristics of Subpart C, nor is it listed under Subpart D.

As a non-hazardous liquid waste, it should be solidified with stabilizing agents (such as sand, fly ash, or cement) so that no free liquid remains before disposal to an industrial waste landfill. A non-hazardous liquid waste can also be incinerated in accordance with local, state and federal regulations.

### SECTION 14 - TRANSPORTATION INFORMATION

Proper shipping name/hazard class may vary by packaging, properties, and mode of transportation. Typical proper shipping names for this product are:

**All Transportation Modes:** Product is not regulated during transportation.

### SECTION 15 - REGULATORY INFORMATION

The following regulations apply to this product.

#### FEDERAL REGULATIONS:

**OSHA Hazard Communication Rule, 29 CFR 1910.1200:**

Based on our hazard evaluation, none of the ingredients in this product are hazardous.

**CERCLA/Superfund, 40 CFR 117, 302:**

Notification of spills of this product is not required.

**SARA/Superfund Amendments and Reauthorization Act of 1986 (Title III) - Sections 302, 311, 312 and 313:**

**Section 302 - Extremely Hazardous Substances (40 CFR 355):**

This product does not contain ingredients listed in Appendix A and B as an Extremely Hazardous Substance.

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## MATERIAL SAFETY DATA SHEET

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### Sections 311 and 312 - Material Safety Data Sheet Requirements (40 CFR 370):

Our hazard evaluation has found that this product is not hazardous under 29 CFR 1910.1200. Under SARA 311 and 312, the EPA has established threshold quantities for the reporting of hazardous chemicals. The current thresholds are: 500 pounds or the threshold planning quantity (TPQ), whichever is lower, for extremely hazardous substances and 10,000 pounds for all other hazardous chemicals.

### Section 313 - List of Toxic Chemicals (40 CFR 372):

This product does not contain ingredients on the List of Toxic Chemicals.

### Toxic Substances Control Act (TSCA):

The chemical ingredients in this product are on the 8(b) Inventory List (40 CFR 710).

### Resource Conservation and Recovery Act (RCRA), 40 CFR 261 Subpart C & D:

Consult Section 13 for RCRA classification.

### Federal Water Pollution Control Act, Clean Water Act, 40 CFR 401.15 / Formerly Sec. 307, 40 CFR 116 / Formerly Sec. 311:

None of the ingredients are specifically listed.

### Clean Air Act, Sec. 111 (40 CFR 60), Sec. 112 (40 CFR 61, 1990 Amendments), Sec. 611 (40 CFR 82, Class I and II Ozone Depleting Substances):

This product contains the following ingredients covered by the Clean Air Act: Urea - Section 111

### STATE REGULATIONS:

#### California Proposition 65:

This product does not contain any chemicals which require warning under California Proposition 65.

#### Michigan Critical Materials:

This product does not contain ingredients listed on the Michigan Critical Materials Register.

#### State Right to Know Laws:

This product does not contain ingredients listed by State Right To Know Laws.

## SECTION 16 - RISK CHARACTERIZATION

Due to our commitment to Product Stewardship, we have evaluated the human and environmental hazards and exposures of this product. Based on our recommended use of this product, we have characterized the product's general risk. This information should provide assistance for your own risk management practices. We have evaluated our product's risk as follows:

- \* The human risk is: LOW.
- \* The environmental risk is: LOW.

Any use inconsistent with Fuel Tech's recommendations may affect our risk characterization. Our sales representative will assist you to determine if your product application is consistent with our recommendations. Together we can implement an appropriate risk management process.

This product material safety data sheet provides health and safety information. The product is to be used in applications consistent with our product literature. Individuals handling this product should be informed of the recommended safety precautions and should have access to this information. For any other uses, exposures should be evaluated so that appropriate handling practices and training programs can be established to insure safe workplace operations. Please consult your local sales representative for any further information.



## MATERIAL SAFETY DATA SHEET

### PRODUCT

**NOxOUT® A**

Emergency Telephone Number

CHEMTREC - 1.800.424.9300 [24 hours]

Fuel Tech, Inc. provides the above information in good faith. Fuel Tech, Inc. provides the above information "AS IS" and makes no representations or warranties of any kind, express or implied, by fact or by law. **FUEL TECH, INC. SPECIFICALLY DISCLAIMS ALL WARRANTIES, INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.**

### SECTION 17 - REFERENCES

Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices, American Conference of Governmental Industrial Hygienists, OH.

Hazardous Substances Data Bank, National Library of Medicine, Bethesda, Maryland (CD-ROM version), Micromedex, Inc., Englewood, CO.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, Geneva: World Health Organization, International Agency for Research on Cancer.

Integrated Risk Information System, U.S. Environmental Protection Agency, Washington, D.C. (CD-ROM version), Micromedex, Inc., Englewood, CO.

Annual Report on Carcinogens, National Toxicology Program, U.S. Department of Health and Human Services, Public Health Service.

Title 29 Code of Federal Regulations, Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA).

Registry of Toxic Effects of Chemical Substances, National Institute for Occupational Safety and Health, Cincinnati, Ohio (CD-ROM version), Micromedex, Inc., Englewood, CO.

Shepard's Catalog of Teratogenic Agents (CD-ROM version), Micromedex, Inc., Englewood, CO.

Suspect Chemicals Sourcebook (a guide to industrial chemicals covered under major regulatory and advisory programs), Roytech Publications (a Division of Ariel Corporation), Bethesda, MD.

The Teratogen Information System, University of Washington, Seattle, Washington (CD-ROM version), Micromedex, Inc., Englewood, CO.

REVISED: 03/15/00



# NOxOUT® REAGENT LICENSEES

LICENSEE CORPORATE OFFICE	ADDRESS	CONTACT PERSON	TELEPHONE No.
<b>CARGILL, INC. *</b>	8813 HIGHWAY 41 SOUTH RIVERVIEW, FL 33569	BILL BASTIAN	(800) 237-2024 (813) 672-7026 FAX: (813) 671-6146
* CARGILL DISTRIBUTION POINTS: ALBANY, NY – CINCINNATI, OH – WELLSVILLE, OH – BALTIMORE, MD ST. PAUL, MN – PHILADELPHIA, PA – MONROE, LA – SACRAMENTO, CA – LOS ANGELES, CA – BRANDON, FL			
<b>PCS NITROGEN, INC. **</b>	1273 TRAIL RIDGE LANE CORDOVA, TN 38016	BRIAN BLAU	(847) 849-4368 CUSTOMER SERVICE: (800) 654-4514
** PCS NITROGEN DISTRIBUTION POINTS: GEISMAR, LA – AUGUSTA, GA – MEMPHIS, TN – LIMA, OH			
<b>MONSON COMPANIES, INC. ***</b>	ONE RUNWAY ROAD P. O. BOX 2405 SOUTH PORTLAND, ME 04116-2406	JEFF PELLERIN	(207) 885-5072 EXT. 423 FAX: (207) 885-0569
*** MONSON COMPANIES, INC. DISTRIBUTION POINT: SOUTH PORTLAND, ME			
<b>AGRIUM USA ****</b> (FORMERLY PRODICA LLC AND UNOCAL CORPORATION)	14027 ROBLAR ROAD SHERMAN OAKS, CA 91423	ALAN LEVY KAREN FORD (CUSTOMER SERVICE)	(818) 817-0975 (877) 700-5490
**** AGRIUM USA DISTRIBUTION POINT: STOCKTON, CA			
<b>HYDRO AGRI CANADA LP</b>	1130 SHERBROOKE STREET WEST SUITE 1050 MONTREAL (QUEBEC) H3A 2M8 CANADA	MIKE DRAPEAU	(514) 849-9222
<b>CDI, INC. *****</b>	P. O. BOX 9083, BREA, CA 92821 OR 471 W. LAMBERT ROAD, SUITE 100 BREA, CA 92821	Luis Cervantes	(714) 990-3940 (717) 329-2281 (CELL) FAX: (714) 990-4073
***** CDI DISTRIBUTION POINTS: DEMOPOLIS, AL – FREMONT, CA – IMPERIAL, CA – STOCKTON, CA WALNUT, CA – KIMBERLY, ID – RIVERDALE, IL – FAYETTEVILLE, NC – MONCURE, NC MOREAU, NY – PORTLAND, OR – MEMPHIS, TN – LIBERTY, TX – PASCO, WA			

## INFORMATION NEEDED BY LICENSEES:

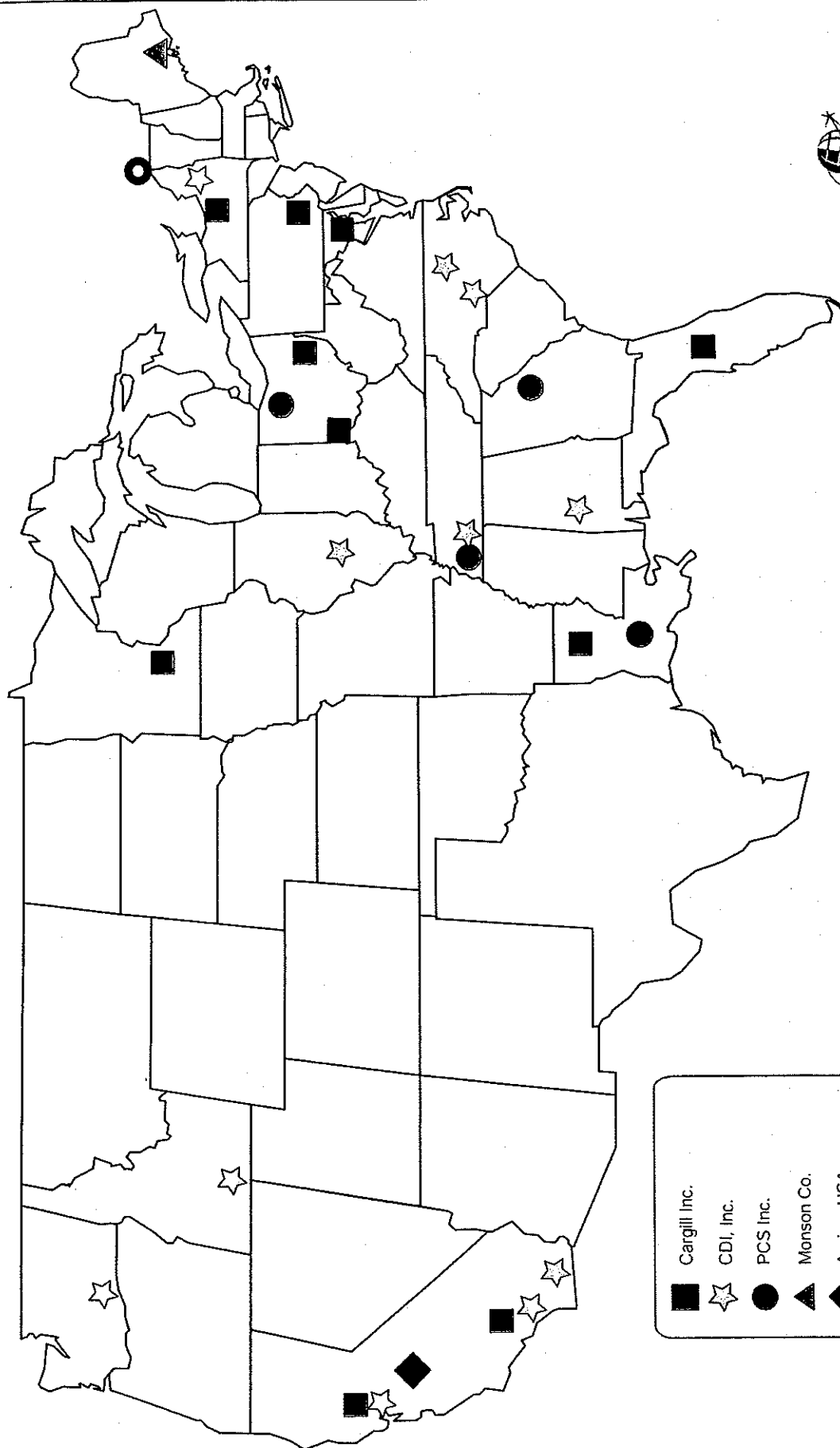
- COMPANY NAME
- LOCATION
- SCHEDULED START-UP DATE
- IF RAIL DELIVERY IS AVAILABLE, SPECIFY RAILROAD

- NOxOUT® REAGENT TYPE REQUIRED (A, HP, LT)
- NOxOUT® REAGENT USAGE RATE
- NOxOUT® REAGENT STORAGE TANK SIZE

REV. 03/24/04

**SOLVAY2016\_1.3\_001450**

# NO<sub>x</sub>OUT<sup>®</sup> A DISTRIBUTION SITES



- Cargill Inc.
- ★ CDI, Inc.
- PCS Inc.
- ▲ Monson Co.
- ◆ Agrium USA
- ◉ Hydro Agri Canada LP



03.26.04



## **NO<sub>x</sub>OUT<sup>®</sup>A**

### **DILUTION WATER QUALITY**

**<450 ppm Hardness as CaCO<sub>3</sub>**

**<300 ppm M Alkalinity as CaCO<sub>3</sub>**

**<60 ppm Silica as SiO<sub>2</sub>**

**<2500 Micromhos Conductivity**

**<8.3 pH**

**<1 ppm Iron as Fe**

**<1 ppm Phosphate as P**

**<0.3 ppm Manganese as Mn**

**IF WATER ANALYSIS SHOWS PARAMETER OUT OF SPECIFICATION,  
CONTACT FUEL TECH, INC. FOR SUPPLEMENTAL APPROACH.**